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Grinding Competition

Most railroad shops now grind piston rods, many of them grind guides, some are grinding axles, and a few grind car wheels. Portable grinders have been found useful in many directions. These operations are fairly well known, but is this as far as you have gone in taking advantage of the possibilities of grinding for rapid and accurate work? With a good grinding equipment, chilled cast iron and case hardened or tempered steel are made available for finished parts. Are you taking any advantage of this opportunity? As a rule the coarser the turning of a part, the greater is the economy of finishing it by grinding. Have you found it wise to change your method of finishing any parts in this way? We would like to know about the latest development in the use of grinding in railroad shops, either in the shape of new ways of performing certain operations; changes in the material or design that have been made possible by the availability of the grinding machine; examples of work that is now being finished by grinding which previously was finished by cutting tools or by hand; original arrangements for safeguarding the operator of grinding machines; or, in fact, anything new in connection with this subject. A prize of $35 will be given for the best article that is submitted to us before October 1, and such other articles as do not win a prize, but are accepted for publication, will be paid for at our regular rates.

Fuel Saving and Capacity

In a paper on the superheater locomotive at the General Foremen's convention, the statement was made that it is claimed the superheater will effect a saving of 25 per cent. in coal, 35 per cent. in water, and increase the horse power or hauling capacity about 33 per cent. One member asked for an explanation of how a 25 per cent. saving could result in an increase of 33 per cent. in capacity, and in view of the fact that a satisfactory explanation was not given on the floor of the convention, and for the benefit of the few who do not already understand it, a simple explanation will be given: Assume that on a saturated steam locomotive 4 lbs. of coal an hour is required for each horse power delivered from the cylinders. Thus, if 4,000 lbs. of coal per hour are burned, it will result in the locomotive delivering 1,000 horse power. Assume that a superheater is applied to this locomotive and that it saves 25 per cent. of the fuel. Under these conditions the 1,000 horse power will then be obtained from burning 3,000 lbs. of coal, or 3 lbs. of coal an hour will give a horse power. Inasmuch, however, as it is perfectly possible to burn 4,000 lbs. of coal per hour, assume that this original firing rate is continued on the superheater locomotive. In this case with 3 lbs. of coal for each horse power and 4,000 lbs. of coal being fired, or the same amount fired to deliver 1,000 horse power on the saturated steam locomotive, the power output will be 4,000 divided by 3, or 1,333⅓ horse power. This is an increas of 333⅓ horse power with the same amount of coal fired, or, an increase of 33⅓ per cent. in capacity on the same fuel consumption due to the use of superheated steam.

Rules of Interchange

The joint annual meetings of chief interchange car inspectors and car foremen of the railways in the country for discussing Master Car Builders' Association's rules of interchange with a view of obtaining more uniform interpretation of these rules, is not only of great benefit to the men themselves, but to the railways at large. With a large collection of rules, like these, there are bound to be misunderstandings, not because the rules themselves are at fault, but because of the different view points of the men, which, when aired in a meeting of this kind, may be corrected. While all should be thoroughly familiar with these rules there are many that do not give the in-

tended interpretation to them, and in these meetings many questions are cleared up. Another advantage of this association, and perhaps the most important, is the discussing of the working out of the rules in practice. These men are much more able to advise as to the needed changes in the rules when acting as a body of co-workers than when offering individual suggestions to the parent organization. That their recommendations are of value is evidenced by the number that have been appointed by the M. C. B. Association. It is important when considering any changes that the opinion of all the members be considered so that a recommendation that will accomplish the greatest good may be made. Although the members of this association are in a position to offer many valuable suggestions, they should remember there are sometimes conditions, with which they are unfamiliar, that make it impossible for some of their recommendations to be accepted, but this should not be allowed to discourage, in the least, their efforts and the continuation of their endeavor to improve matters as they see them. Apparently it has not and will not.

Master Blacksmiths' Convention

In the discussion of flue welding at the Master Blacksmiths' Association convention, it was brought out very clearly that the increasing use of superheaters in locomotives has required the introduction of special tools and methods in more than one branch of repair work. In one instance where modern locomotives are repaired in a comparatively old shop it has been found impossible to remove superheater flues from the boilers because of lack of space, unless the doors of the erecting shop are opened, which, in a northern latitude, is out of the question in winter. This has been overcome by constructing a special type of cars which close the door openings and also provide a platform for the workmen. It is quite probable that there are other shops similarly situated, where either a new building or an extension of the old one is being considered and an arrangement of this kind could be applied with a resultant saving.

In the discussion on tools and formers there was a wide variation of opinion. Some of the members seemed to think that it pays to make a tool for any job, no matter how small, while others placed limits, varying from 12 to 100, on the number of pieces to be made for which it pays to provide a special tool. This is a question for which a definite answer cannot be given; in large shops where hundreds or thousands of one piece are frequently required, no one can deny that a large saving can be effected by making special formers, but there are many small shops in which it would be a waste of money to employ such methods.

In the paper on electric welding it was brought out that at the New York Central shops at Depew, N. Y., this process has been successfully used to fill in flat spots on locomotive driving wheel tires, some of the spots being 4½ in. long. With the soft metal which is used it scarcely seems probable that this practice could be of any very lasting benefit as, even if the wheels were not slid again on the same spots, it is probable that the ordinary wear and tear of service would soon affect the soft metal, causing a return of the flat places.

One of the most interesting reports was that on spring making. With the weight of locomotives and cars what it is today, the very best methods and materials should be used in spring manufacture, yet there are hundreds of shops where the methods used in making springs that had less than one-fourth the weight to bear are still employed on the large modern springs. The use of machinery and the heat treating of the steel should result in great improvements. An example given in the report was the making of 18,000 leaves by this process without one of them failing under test. Stress was laid on the use of the recording pyrometer. To the smith of the older days, accustomed to judge temperatures, this may seem unnecessary, but there is no doubt that the pyrometer will assist greatly in obtaining uniformity of tempering.

Traveling Engineers' Association

In past years the Traveling Engineers' Association has made itself a reputation for getting the maximum of real value from its annual meeting. This year's convention fully maintained the previous standard. For size of attendance at, and interest in, the meetings, the evident desire of the members to receive and impart the greatest amount of information, close adherence to the subject under discussion, frankness of expression, selection of most important and most suitable subjects for discussion and dignified parliamentary control of the meetings, there is no association in the mechanical field which exceeds the Traveling Engineers' and, considering all of these features together, there is none that equals it. All the other associations can learn something by studying the work of the Traveling Engineers.

Not the least important feature of the success of these meetings is the wisdom of selecting a few really important subjects which are strictly within the limits of the Traveling Engineers' province and giving plenty of time for a full discussion. This year there were five subjects for four full days' sessions. The meetings were in session for a total of about 21 hours, and if six hours are excluded for the amount taken by addresses and routine business, it leaves an average of three hours for presentation and discussion of each report.

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Warning has been given several times in these columns as to the advisability of giving closer attention to the water level of the superheater locomotive boiler, that it is not carried too high. In speaking on this subject, one of the members at the Traveling Engineers' convention stated that on the large number of superheater locomotives he had been on, over 60 per cent. were carrying water over into the superheater due to the level being maintained too high. While probably this percentage is excessive in most cases, still, as was shown by the report of the Committee and the comment of the other speakers, in far too many cases is the water level too high on superheater locomotives. The whole trouble is probably due to a lack of thorough understanding by the engineer of the effect of carrying water over into the superheater units. It is hard to believe that any engineer would handicap his locomotive to this extent if he realized what was going on. Unless a pyrometer is fitted, which will show the temperature of the steam in the superheater, it is very difficult for an engineer to know if water is being carried over and his only safeguard is to carry a level low enough to be sure that a minimum is being carried through the throttle. It is even doubtful if all traveling engineers fully understand the bad effects of this practice and it is probable that, as a result of this convention, there will be far less reason to complain on this score in the future than in the past. A number of locomotives have been equipped with pyrometers which have proven to be of great assistance to the engineer in the operation of his locomotive in obtaining the best return from the superheater. Where pyrometers are used, if any water is carried over it immediately shows in a sharp dropping in the temperature and the trouble can be corrected immediately. Furthermore the best relation of throttle opening and cutoff to obtain the highest degree of superheat can be quickly discovered. In connection with the latter feature, the members were advised by a superheater expert to use a full throttle up to the point where the cutoff reached 25 per cent. of the stroke. When, however, it became necessary to shorten the cutoff beyond this it was more advisable to close down the throttle than to use a cutoff less than 25 per cent.

Among the other features of superheater locomotives that received considerable discussion were the matter of insuring the

cleanliness of the superheater unit and the lubrication of the locomotive. With some grades of fuel it is only by using the utmost care that the superheater flues and the units can be kept clean. Blowing them out with a high steam or air pressure in a ⅜-in. pipe of sufficient length to reach through the tube is successful in most cases, if the operation is performed frequently enough, but in others there is a collection of scale and cinders which cannot be blown out and even after the passage of this pipe, inspection will show a solid mass around and between the superheater pipes in the unit. In some cases the collection of cinders is so bad that the small pipe cannot be forced through and in one extreme case, it is mentioned that the turntable had to be used to pull a superheater unit out of its tube. It was clearly understood by everyone, however, that no matter how difficult it may be, it is absolutely necessary that these units be kept clean, otherwise the capacity of the boiler will be greatly reduced and an engine failure invited. Blowing them out with air or steam pressure, as recommended, supplemented by careful inspection and the use of bars or hooks to dislodge the clinkers will do it successfully and no traveling engineer or roundhouse foreman should allow a locomotive to leave the terminal until he is sure that this has been done.

Lubrication of the cylinders and valves did not seem to be causing as much trouble as it did on the first introduction of the superheater. A good grade of valve oil will properly lubricate these parts if it is used effectively but positive assurance must be had that the lubricant is being distributed uniformly and constantly. Oil pipes direct to the cylinders do not seem to be necessary in all cases, although their presence and use is advised when the locomotive is drifting for any considerable distance. Flaked graphite fed to the valves and cylinders in small quantities has been successful on both superheater and saturated locomotives but the experience of several of the members indicated that care must be taken not to overdo the matter and feed too much graphite, as in that case the packing rings would stick solid and difficulty with blows would be incurred.

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That the efficiency with which the operating department performs its duties has a very direct and marked effect on the coal consumption of locomotives is well known to all mechanical men, but it is doubtful if the same features are thoroughly appreciated by the minor officials in that department. The report of the committee on this subject at the Traveling Engineers' convention listed the more important of these activities where the results of the work of the operating department had an effect on the coal pile. Coal wasted by locomotives standing at terminals waiting for trains was believed to be one of the greatest sources of waste. Several experiments were mentioned by the members where the locomotives were run over two divisions continuously, only stopping at the intermediate terminals long enough to renew the supply of coal and water and to clean the ash pan. There is no doubt but this practice will result in a very distinct saving of fuel and it is being used on quite an extensive scale already by some of the more progressive roads. Coal wasted by overloading the locomotive and thus requiring a very long time on the road is another feature under the control of the operating department in which there can be considerable improvement on some roads. Many other conditions were mentioned in the report and by the members discussing it, but so far as appeared there had been very little conscientious effort to educate the minor operating officials in their responsibilties and opportunities in connection with the fuel account. Advice was extended to the members that whenever an opportunity for the operating department to save fuel comes under their observation, they should take the matter up with the proper official and present actual figures to show the advantage of a different policy.

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Splendid results are following the efforts being made to reduce black smoke, particularly within city limits. In the opinion of most of the members light and level firing, sufficient air openings in the ash pan and the use of the brick arch, especially when these are assisted by steam jets through the side water leg and in the back head, will make possible practically smokeless firing. The greatest offenders in the smoke nuisance have always been the switch engines which, due to the intermittent operation and frequent use of full stroke have made it very difficult to maintain a smokeless condition in the firebox. The application of the brick arch and superheater, however, appears to have changed all of this and it is now possible to have a most successful switching locomotive which can operate at full power and practically without smoke. It is, of course, not to be inferred that the superheater has any effect on the smoke *per se*, but the fact that it saves about 50 per cent. of the fuel, permits much lighter fires to be carried and allows the fireman to exercise more care in its distribution. Avoiding smoke at roundhouses is, of course, a much more difficult proposition, but the majority of the members seem to believe that even here, with proper facilities and proper care it could be very greatly reduced. The Lake Shore & Michigan Southern seems to be having some success with the use of smoke washers at roundhouses. In these cases the smoke is all discharged into a duct around the house in which a suction fan makes circulation and discharges the smoke in vats of water which remove all of its objectionable properties. The reduction of black smoke in the neighborhood of cities is a very important matter and the sentiment expressed at this meeting was most encouraging and if the actual achievement meets the expectations, the greatest cause of public demands for expensive electrification in cities will be eliminated.

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Mr. Parish in his paper on the brick arch stated quite truly that the value of the arch tube as a means of better water circulation has not received the attention it deserves. He states that four 3-in. arch tubes, when the boiler is working up to its capacity, will circulate fully 30,000 gals. of water an hour when the discharge end of the tube is designed to discharge at the surface of the water. This is practically nine times the total amount of water in the boiler of a large consolidation locomotive and in view of the fact that these tubes are at the hottest point of the firebox and have the greatest temperature difference between the inside and outside of the tube, and are thus capable of transmitting the larger proportion of heat, their value as heating surface is much greater than any other part of the boiler. In this connection Mr. Gaines mentioned in his discussion that he had found the thin arch tubes much better than the thicker ones and is now using tubes .15 in. in thickness. In connection with this rapid circulation feature Mr. Parish gives warning about using a tube smaller than 3 in., stating that as the diameter of the tube bears a direct relation to the amount of water circulated, if the tube is reduced to any considerable extent it is probable that there will be no circulation except that required to replace the water evaporated in steam in the tube. Or, in other words, the tube would flash the water into steam of high temperature and practically no water would be carried out with the steam.

NEW BOOKS

Engineer's Handbook on Patents. By William Macomber, Professor of Patent Law, Cornell University Law School. Illustrated. Bound in flexible leather. 270 pages, 4½ in. x 6¾ in. Published by Little, Brown & Co., 34 Beacon street, Boston. Price, $2.50.

This book is a distinct departure from the orthodox order of works on patent law and is, as its title indicates, a handbook in which there are presented the theories which underlie successful invention and tend to guide the inventor along successful lines, both as to law and theory of patents. The information given will tend to enable the inventor to avoid lines of thought which have resulted in past failure, and will inform him

on the steps necessary to secure for himself the full benefit of a successful invention. The section on what is patentable is exceptionally detailed and complete. Special attention has been given to indexing and paragraphing with a view of making the contents accessible with the utmost directness.

Holmes Hinkley, an Industrial Pioneer. Edited by Walter S. Hinchman. Bound in cloth. 42 pages. 5½ in. x 8 in. Illustrated. Published by the Riverside Press, Cambridge, Mass. Price $1.00.

Holmes Hinkley built the first locomotive from original design in New England. This locomotive was called the Cumberland, and was built for the Portland, Saco & Portsmouth Railway, in the year 1840. About a year before he died in 1866, Mr. Hinkley wrote a brief autobiography which has been made the basis of this book. Letters from those who either knew him or his work and various data of interest have also been included, together with several illustrations of his early locomotives. The edition has been strictly limited, and but few copies are for sale.

Laying Out for Boilermakers. Second edition. Bound in cloth, 302 pages, 10 in. x 13 in. 600 illustrations. Published by the Aldrich Publishing Company, 17 Battery Place, New York. Price $5.00.

The first edition of this work, which was published about three years ago, clearly indicated the demand for a thoroughly practical instruction book on the laying out of work of all kinds. The second edition, now being published, contains over twice as much reading matter as did the first, and all parts have been revised and enlarged. The book is thoroughly practical in every particular and is fully illustrated. It explains how to lay out various different types of boilers and all of their parts. Proper procedure in making repairs, particularly to locomotive boilers is fully covered and chapters are given on the construction of steel stacks and on various miscellaneous problems, such as laying out Y-breeching, elbows and various other unusual and odd forms. A new chapter in this edition is one given under the title of Miscellaneous Calculations, which shows how to determine the efficiency of riveted joints, the area of circular segments, how to estimate the cost of different types of boilers, etc. The last chapter is devoted to tools for boilermakers and how to use them. Both machine and hand tools are described and illustrated in this chapter. This book will be found useful by all boilermakers and would be of particular value to a boilermaker apprentice.

Engineering as a Profession. By A. P. M. Fleming and R. W. Bailey. Bound in cloth. 278 pages. 5 in. x 7½ in. Published by John Long, Ltd., Norris Street, Haymarket, London. Price 75c.

The authors of this work have had considerable experience supervising the technical and practical training of young engineers, and the opinion has been forced on them that the large number of failures in this field are due to a lack of knowledge as to what constitutes a suitable course of training and ignorance of the conditions governing engineering employment. To supply this deficiency they have written this book, which aims at giving a broad general outline of the field of engineering activities for the benefit of those who have only a popular conception of engineering matters and a comparison is drawn between engineering and other well recognized professions. The book is written entirely from an English standpoint and the methods for obtaining training in that country are fully discussed. Full information is given in regard to various scholarships and other facilities for obtaining engineering education and training at the minimum of expense. A brief outline is given of the apprenticeship courses in the various prominent works in Great Britain, and considerable information is included for the benefit of young engineers going to England from other countries for education and training. This book is an excellent commentary on English engineering education, facilities and practices.

COMMUNICATIONS

TRUCK WHEEL TIRE TURNING TEST

CHICAGO, Ill., July 23, 1913.

To the Editor:

The accompanying table gives the result of a truck wheel tire turning test performed at the Chicago shops of the Chicago & North Western, June 26, 1913. The work was started at 7 a. m., and performed by a regular lathe operator and his regular helper. No extra help of any kind was used, and all the wheels turned were so worn that their removal from service was required. Twenty-four pairs of wheels were turned in 6 hrs. 22 min., with an average time from floor to floor of one pair of wheels in 15 min. 55 sec. The fastest time from floor to floor was 12 min. 40 sec. A 42-in. Niles-Bement-Pond lathe operated by a 55 h. p. d. c. General Electric motor was used. The total weight of chips was 13.92 lbs.

Number of pair.	Diameter of Rough Wheel.	Diameter of Finished Wheel.	Time, Floor to Machine. (Min. and Sec.)	Time of Turning. (Min.)	Machine to Floor.	Total Time, Floor to Floor.	Speed. (Ft. per Min.)	Feed. (In. per Min.)	Condition of Tire.	Depth of Cut Outside Tread of Wheel.
1	29½	29⅛	1.20	16.30	1.15	19.5	13	⅜	....	5/16
2	28 5/16	27¾	2	10.15	1.10	13.25	15	⅜	....	⅜
3	28 7/16	28¼	2	10	1.10	13.10	15	⅜	Hard spot	¼
4	31	30¾	2	10.30	1.20	13.50	15	⅜	....	¼
5	28 7/16	28 5/16	2	10	1.10	13.10	15	⅜	Hard spot	¼
6	28⅝	28 3/16	2	11	1.10	14.10	15	⅜	....	5/16
7	30⅛	29 9/16	2	13	1	16	15	⅜	....	7/16
8	30 3/16	30	2.10	11.10	1	14.20	15	⅜	....	⅜
9	29 13/16	29 9/16	2	10.30	1	13.30	15	⅜	....	¼
10	29 13/16	29 7/16	2	11	1.10	14.10	15	⅜	....	5/16
11	31¼	30 13/16	1.50	10	1	12.50	15	5/16	....	¼
12	27¾	27 9/16	2	10.30	1	13.30	15	½	....	⅜
13	30	29¾	2	12	1	15	15	⅜	Hard spot	5/16
14	31	30¼	2	30	1.10	33.10	15	⅜	....	½
15	28 5/16	28⅛	2	17	1	20	15	⅜	Hard tires	¼
16	31 5/16	31 3/16	1.40	10	1	12.40	15	⅜	....	5/16
17	30⅛	30	2	11	1	14	15	⅜	....	¼
18	30 1/16	29 13/16	2	13	1	16	15	⅜	....	¼
19	30⅛	30	2	11	1.10	14.10	15	⅜	....	5/16
20	30⅞	30⅝	1.40	18	1.20	21	13	3/16	Hard spot	⅜
21	30	29⅞	2	11	1.20	14.20	15	⅜	....	¼
22	30 5/16	30⅛	2	12	1.10	15.10	15	⅜	....	5/16
23	30⅞	30 11/16	2	10	1.10	13.10	15	⅜	....	⅜
24	30⅞	30¾	2	19	1.10	22.10	14	⅜	Hard spot	⅜

E. H. MOREY,
Demonstrator.

NEW LOCOMOTIVE ENGINE.—We were much gratified a day or two since by a visit to the machine shop of William B. James, No. 40 Eldridge street, where we saw in operation on a short temporary railway in his yard, a locomotive engine constructed upon an entirely different plan from any that we have before seen. No part of the engine except the boiler and smoke pipe is over 39 in. above the surface of the rails and it is so constructed that no fire falls from the furnace nor is a spark even seen to rise from the smoke pipe. The cylinders are on the outside and below the top of the wheels. It is to carry its own fuel and water, and the fire is driven by a bellows worked by the machinery, and therefore is always in proportion to the velocity. It is estimated to weigh, with the supply of water and fuel on board, 3½ tons, and to run from thirty to forty miles an hour. Its power is equal to 16 horses. To give some idea of the ease with which it is controlled when under way, we saw it run a distance of about 50 ft. forward and backwards eight times in 63 seconds, including stops. Mr. James placed it upon wheels without flanges a few days since and ran it over the pavements on Third avenue to Yorkville, about five miles, took breakfast and then returned to the city. The performance, he said, was altogether satisfactory. He has it in contemplation to take it to Baltimore in a few days to give it a fair trial. It will be found, we predict, an ingenious and valuable addition to those already in successful operation on their railroads. We wish Mr. James success, for his plan is called the American.—*From the American Railroad Journal, October 20, 1832.*

TRAVELING ENGINEERS' CONVENTION

Large Attendance and Active Discussion Made the Twenty-First Annual Convention Very Successful.

The twenty-first annual convention of the Traveling Engineers' Association was opened at the Hotel Sherman in Chicago, on August 12, by President W. H. Corbett, master mechanic, Michigan Central, Michigan City, Ind. After the opening prayer by Rev. Samuel Fallows, D.D., the convention was welcomed to the city by the assistant city attorney.

W. A. Garrett, vice-president, Chicago Great Western, delivered the opening address. Mr. Garrett complimented the members on the success that has followed their efforts in training the engine crews and pointed out the great value of team work among the employees of a railroad. All are working toward a common end and the co-ordination of their efforts cannot help but improve the results. Increasing government regulation of railroads makes necessary even greater and more conscientious efforts on the part of all employees if the properties are to be in any sense successful.

Attention was drawn to the very large number of people killed or injured by the railroads, it being pointed out that on an average there are 14 people killed each day. A very large part of these are trespassers, and it becomes the duty of railway employees of all classes to prevent trespassing as far as they are able. Efforts in this direction will probably reduce the total number killed more than any other way. Statistics compiled by the Interstate Commerce Commission as to the causes of the principal train accidents which occurred for the past 10 years were quoted by Mr. Garrett. Out of a total of 535, excessive speed was responsible for 137 accidents, 95 are charged to carelessness, while 69 were due to misread orders. Other causes of accidents quoted were: 66 due to running past signals; 63 to disobedience of rules; 49 to forgetfulness; 40 to someone falling asleep, and 16 to failures to follow the schedule. It was pointed out that the traveling engineer has it within his power to greatly reduce a number of these accidents, and in fact it has devolved very largely on him to do so.

Mr. Garrett stated that the obligations of the employer toward the employee do not end with the pay envelope. The success of the employer depends on the well-being and high standing of his employees. And again, the success of the employee depends on the success of the employer and the success of a railroad depends on the prosperity of all.

ADDRESS OF THE PRESIDENT.

President Corbett confined his remarks very largely to pointing out the possibilities of the Traveling Engineer and the necessity for him being thoroughly conversant with all the new devices that are placed on a locomotive. It is only through the traveling engineer that the engine crew can be properly instructed and trained, and to a large extent it devolves on him to see that the proper returns are obtained from the investment in improved designs and economy devices that are placed on locomotives. It is vitally necessary at the present time to obtain full results from every device that will lead toward economy of locomotive operation and the railroad companies look to the road foreman of engines for this accomplishment.

OPERATING SUPERHEATER LOCOMOTIVES

Following is an abstract of a committee report entitled, "Uniform Instructions to Enginemen on Handling of Superheater Locomotives."

Superheaters of various design, capable of developing a moderate degree of superheat, have been experimented with, but the results obtained have not been of sufficient value to warrant their adoption, and they have gradually given way to the fire-tube type, which has been adopted as the most efficient and economical means of superheating. It is therefore proposed to consider only this type.

The principal advantages derived from the use of superheated steam are: The increased volume of steam delivered per unit of water evaporated, the prevention of cylinder condensation, and a much smarter engine. When we consider the fact that the heat losses in the cylinders of a saturated steam locomotive average 30 per cent., due to cylinder condensation, which is eliminated with highly superheated steam, and in addition there is an increase in volume, it is an easy matter to see why the superheater locomotive produces such remarkable results in the way of efficiency and economy.

Add to this the fact that the efficiency of the superheater locomotive increases as the load increases, while it is the reverse with saturated steam, and we have the reason for its being generally adopted.

In the operations of a superheater locomotive it is necessary, as with all other devices, in order to obtain the most efficient and economical performance, that the enginemen be familiar in a general way with the construction and operation of the superheater as well as the nature of superheated steam, and while the operation does not require any radical departure from what has been the recommended practice for saturated steam locomotives, there are some operating features which, if followed closely, will produce the desired results, while on the other hand, if they are not followed, the results are unsatisfactory and the full efficiency and economy of the superheater locomotive will not be obtained.

DRAFTING AND FIRING.

One of the most important features to be considered is firing. Inasmuch as the efficiency of the locomotive increases as the degree of superheat increases, it can readily be seen that the flame temperature in the fire-box is a very important factor and it is quite necessary that the draft appliances be so constructed as to produce an even, steady pull over the entire grate, and a draft condition that will make the locomotive a free steamer. In order to obtain this, it is generally necessary to use a somewhat smaller nozzle, draft-pipe and stack arrangement.

On account of the smaller volume of exhaust steam and its higher velocity, a moderate reduction in the size of the exhaust nozzle does not produce the same bad effect as with saturated steam, and its reduction to produce the desired draft conditions may be reached before there is any noticeable effect in the way of back pressure. However, the necessity for these changes depends much on the quality of fuel used and the operating conditions.

Firing should be light and regular and a high flame temperature maintained.

Keep a light fire, a bright fire and a level fire, and if you do this you will have a hot fire and this is necessary to obtain best results. Close the fire-door after each shovelful.

Banked fires and applying fuel in large quantities must be avoided, as this practice produces a low flame temperature, which materially reduces the degree of superheat and affects the economy and efficiency of the locomotive.

The kind of coal to be used has to be considered. For illustration: A superheater locomotive will give less trouble and will be more efficient using Colorado or New Mexico coal than it will with Iowa or Arkansas coal; this is on account of the former coals being almost free from clinker and slag forming properties, while the latter is very bad to clinker the grates and honey-

comb the tubes, superheater units and flues. This is especially true during wet and snowy times when the percentage of moisture is high in the coal, all of which has to be evaporated before the coal will burn, and while this evaporation is taking place, instead of having a white burning fire, we have a red, smoky looking fire that has a temperature just up to the melting or fusing point, and the impurities which are present more or less in nearly all coal, melt and run and form clinkers in the fire and on the flue-sheet, in tubes and flues. This occurs worse with old flues than with new ones.

The way the engineer starts his train has much to do with this also. If in starting he gives his engine too much throttle, the first move causes the engine to slip, which helps to form clinkers and honeycomb on the flue-sheet and superheater units.

When making a terminal start, the condition of the steam being used is exactly the same as ordinary wet or saturated steam, and this condition continues until the superheater elements get heated, the steam gradually getting hotter and hotter and dryer and dryer. Enginemen should be interested in having flues kept clean.

Any stoppage of the flues reduces the boiler heating surface and in case of the superheater flues also reduces the degree of superheat, as the steam passing through the unit contained in the plugged flue is not superheated and when it is delivered in the superheat portion of the header its effect is to reduce the temperature.

The enginemen should report promptly any indications of trouble in the front end, or other trouble that will in any way affect the free steaming of the locomotive.

Experience has shown that a very bad condition can exist in the front end of the superheater locomotive, and still the performance be reasonably satisfactory. Many cases have occurred where these conditions have become bad enough to cause a failure ordinarily before it was known that there was anything wrong.

Enginemen should always bear in mind that if a superheater locomotive does not steam freely there is something wrong which should be corrected at once.

Enginemen should report promptly any failure of the superheater damper to work properly, and in case it fails to operate on the road the damper weight may be tied up to hold the damper in open position until the trip is completed, and to avoid a failure.

If for any reason the damper on a road locomotive does not close when the throttle is closed, the engineer can always protect the superheater units from overheating by slightly cracking the throttle when in his judgment it is necessary.

BOILER FEEDING.

Enginemen should feed the water regularly and carry it at a uniform level, making sure that it is not high enough to carry over into the superheater.

Any water carried over into the superheater will be evaporated by the heat passing through the large flues and in this case the superheater is being used as an auxiliary boiler with little or no superheat obtained. This is one of the most common and expensive mistakes made in operating this class of power.

Enginemen should bear in mind that the water consumption should be about one-third less than with a saturated steam locomotive in doing the same work and should regulate the boiler feed accordingly.

Enginemen should avoid the practice of filling the boiler too full before starting or when drifting. Otherwise the locomotive will be slow getting under way, due to the superheat coming up slowly, and usually the engineer runs two or three miles before it is necessary to apply the boiler feed and much steam is wasted at the safety valves.

Enginemen should always note the height of water in the boiler when taking charge of a superheater locomotive and should not attempt to move it until the air pressure is pumped up and the brake in operation.

The common practice of filling boilers too full of water in engine houses and yards makes the above instructions necessary, because when the boiler is too full and the throttle is opened, the large volume of water passing into the superheater makes it difficult to handle the locomotive, particularly if the engineer is not aware of the conditions. This, however, is a very bad practice and should be stopped.

Cylinder cocks should be open before starting and remain open until dry steam appears, except when making station stops, when there is not liable to be any condensation in the cylinders.

Enginemen should run with a wide open throttle when the working conditions will permit and with as short a cut-off as is consistent with the proper handling of the train.

It is not expected that an engineer will attempt to run with a wide open throttle with a very light train and he should not handle a heavy train with a light throttle and an unnecessarily long cut-off.

Enginemen should bear in mind that the application of the superheater has practically increased the boiler capacity and as the efficiency of the locomotive increases in proportion to the increased pull on the draw-bar, they can work the engine much harder than is possible with saturated steam, when occasion requires it.

LUBRICATION.

Owing to the fact that there is no moisture in superheated steam to assist in lubricating, it is generally necessary to use a little more oil than with saturated steam.

Enginemen must know that the oil feed to valves and cylinders is constant and where the cylinders are equipped with an independent feed about 75 per cent. of the oil should be fed to the valves and 25 per cent. to the cylinders. When the cylinders are not equipped with independent feeds and all of the oil is delivered in the steam way or steam chest, no reduction should be made in the total amount of the oil used.

Owing to the high temperature of the valve and cylinder walls when shutting off, and particularly at high speeds, it is considered necessary to admit a small amount of steam when drifting, in order to prevent the oil from carbonizing and also to prevent drawing in hot gases from the smoke-box.

In many cases special means of admitting steam to the valves and cylinders is provided, but in the absence of this it is recommended to slightly crack the throttle when drifting until such a time as the valve and cylinder walls cool down.

If you keep enough steam in the cylinders when drifting to keep the air and smoke-box gases out, you will have very little trouble about lubricating with any of the best valve oils furnished. In other words, if you keep the steam pressure in your cylinders above atmospheric pressure, air won't get into the cylinders. It won't run in against a higher pressure any more than water will run up a hill, and the oil won't burn without air, It is just as necessary to have air to have a fire as it is to have fuel. In fact, it is the air that burns. It takes air, fuel and temperature for a fire. Steam, fuel and temperature will not burn. Steam in many cases is used to extinguish mine fires. The ability of the oil to adhere to the surfaces to be lubricated is very important.

It has been learned from experience that a great many of the troubles formerly attributed to insufficient or defective lubrication have been eliminated by the proper delivery of the oil, and the use of metal in valve chambers and cylinders most suitable to high temperature, and more care in fitting up the parts coming in contact with the superheated steam.

Enginemen should be prompt in locating and reporting blows; and any report of this nature should receive prompt attention.

Keep your ear on the alert for blows in valves and cylinders; the steam you are using now travels faster than it used to and carries away a great deal of your lubrication when blows occur.

DONT'S.

Don't expect too much out of the superheater; it is not intended to overcome blows or supply steam leaks or square valves, and it is like some children—won't keep itself clean.

Don't forget when switching that there is more steam between the throttle and cylinders with the superheater than with the saturated steam engine—the superheater holds some.

Don't carry water too high just because you don't hear any in the smoke stack. You might be using your superheater to boil water instead of heating steam.

Don't think because your engine steams that you are getting the full value of the superheat; your engine may not be calling for the capacity of your boiler.

Don't close your throttle entirely on road engines until you are going quite slow; your cylinder lubrication will be much better.

Don't shake the grates violently when the engine is working hard; it causes the tubes and superheater units to choke up more frequently.

Don't fire your coal too wet; it won't clinker so badly if reasonably dry. The more you rake the fire the more the flues will stop up. There are only two reasons why a fire should be raked: one, because too much coal is used, and the other because it is not put in the right place.

While there is a great difference in coal, there is not as much difference as in what you are able to get out of it. They tell us of the high number of heat units or B. T. U.'s in certain coal; what does that amount to, to us, if we are not able to catch them, harness them up and use them to our advantage?

Keep after the terminal forces to clean the superheater units. Watch this a little when you have an opportunity. You are liable to find them using anything from a short flue auger to a 1½-in. pipe. They should use about a ⅜-in. pipe, long enough to go through the flues, and this should be used with a high air pressure, along with suitable hooks and scrapers to fully clean the superheater units. If it is not done in this way, they will not be clean, and the money invested in the superheater is worse than wasted, because you will then have a saturated steam engine with a low-pressure boiler with decreased heating surface, impaired water circulation drafted too strong through lower flues, causing holes to come through the fire near the flue-sheet, which has a tendency to make them leak. If this is allowed you have a low pressure saturated steam engine with big cylinders, and generally nothing to put in them.

Committee: J. W. Hardy, chairman; Sheridan Bisbee, W. A. Buckbee, B. J. Feeny and J. W. Heath.

DISCUSSION.

The use of a full or partially open throttle on superheater locomotives was the subject of an extended discussion. Strong advocates of both methods were heard and concrete examples were related where each method had proved to be the better. In one case a test was reported where the temperature of the superheater was recorded and it was shown that when operating with a full throttle, as the speed increased and the cut-off was shortened, the temperature in the superheater continued to decrease, but when the cut-off was lengthened and the throttle partially closed the temperature again reached 680 deg. Some members advocated the use of a light throttle in freight service in connection with a long cut-off, but the use of a full throttle and very short cut-off in passenger service with superheater engines. It finally appeared that the proper method of operation is the use of a full throttle up to the point where the cut-off is 25 per cent. If it is necessary to use a shorter cut-off than this it is advisable to close down on the throttle in preference to shortening the cut-off.

One member claimed that as high as 60 per cent. of the superheater locomotives he had seen in operation carried the water too high and made a steam generator of the superheater. Some of the other members who had had much experience with superheater locomotives had not found the proportion as large as this, although in a number of instances they reported trouble in getting some of the crews to carry the water low enough. In cases where pyrometers are applied, the difficulty with high water is not encountered, as the presence of water in the superheater is indicated by a sudden reduction in the temperature of the superheater.

It is claimed that when converting a saturated to a superheated engine the best results are obtained by reducing the nozzle from 10 to 15 per cent. and using a smaller stack. The reason for this is that the total weight of steam discharged through the nozzle is considerably less than that for saturated steam, and a small nozzle will give the desired draft to better advantage. This reduction in the size of the nozzle, however, does not increase the back pressure.

Considerable discussion arose on the subject of cleaning the superheater. The paper recommended the use of a ⅜ in. pipe, but one member strongly objected to this size, claiming that it was not possible to bend a pipe of this size of the necessary length so as to get it to properly enter a long superheater tube. He recommended the use of ¼ in. pipe. Other members, however, seemed to have found no difficulty in using the ⅜ in. diameter. It was generally agreed that thorough cleaning of the superheater units and tubes was not only necessary, but almost vital for the success of the appliance. It was also agreed that it was only with the greatest care that a thoroughly clean surface could be maintained. One member explained the construction of an electric lamp with a reflector so that the light could be thrown in the tube and disclose any cinders or clinkers that might still remain around the unit. He has found it necessary in some cases to use a long bar with a hook on the end, in order to dislodge the clinkers around the unit supports. Cases of where the turn table had been used to remove a unit from a tube were mentioned. This was due to the collection of cinders and clinkers around the unit and its supports, cementing them in place. In connection with the difficulties caused by the formation of honeycomb it was explained that coal, if less than 2 per cent. sulphur, will not clinker or honeycomb, and also that it is only at the high temperatures that honeycomb forms. It was also suggested that leaks might be responsible for the starting of honeycomb, but the general evidence was that a very high temperature with certain qualities of coal was the principal reason for it.

Lubrication of superheater engines appears to have caused trouble in some cases. A number of instances were related where ordinary Perfection valve oil in comparatively small quantities had been successful on superheater engines. It was recommended that the use of cylinder oil feed be confined to the time when the engine was not working steam, and that as soon as the throttle was open the cylinder feed be cut off.

Graphite lubrication has been very successful at two points where it has been tried. Care is necessary, however, not to use too much graphite. One member explained a test with a 4,000 ton train for a distance of 150 miles. The run required 25 hours. This superheater locomotive was lubricated by feeding oil only to the valve and but 3½ pints of valve oil were used, giving most excellent results in every particular. Superheater oil can be successfully used, but in many cases it appeared that it is not required, as the Perfection valve oil gives satisfactory lubrication.

THE OPERATING DEPARTMENT AND FUEL ECONOMY

A committee report on "Credit Due the Operating Department for Power Utilization and Train Movement that Reduces the Consumption of Fuel," was presented, of which the following is an abstract:

For the purposes of this paper it is assumed that the operating and mechanical departments are to be considered as distinct

units. The operating department consists of officials usually known as general superintendent, superintendent of transportation, division superintendent, trainmasters, train despatchers, yardmasters, etc., or those who have to do with making up and despatching trains. The consumption of fuel per ton mile is variable and dependent on many conditions, two of which come within the province of the operating department. When the power is ready for service, fuel burned while it is waiting to be utilized might be considered by the strict economist as being wasted, as no direct earnings result from its use. Fuel burned during the time beyond that in which the train should be delivered at destination under average favorable conditions might also be considered wasted. The relation which the operating department has to economical consumption of fuel lies in its control of the above two items through its connection with power utilization and its supervision of train movement.

The study of fuel economics is scarcely a duty of the operating department, but moving trains and handling power in connection therewith are its chief duties and on the efficiency with which it performs these functions a low or high fuel consumption largely depends. Its opportunities for aiding in keeping down fuel consumption through betterments of many underlying conditions, well within its charge, that have an indirect bearing on promptness with which power can be utilized and trains made up and delivered, are far from limited. Credit is due it for betterments that result in actual savings in fuel and for endeavors to take advantage of opportunities tending to further savings. The true credit due is proportional, however, to the utilization it makes of these opportunities as a whole, considering possible savings that could be made if all were taken advantage of. While credit is due any department for every pound of fuel saved, the credit is grudgingly given if it is known that conditions exist, capable of remedy, whereby two pounds might be saved, where but one was saved. Paradoxical as it may appear, a seemingly low fuel consumption per ton mile may actually be a high consumption, and the maximum amount that should be used may be less than the minimum amount being used through adverse conditions of operation which might be reduced to a minimum if proper efforts were made.

Among the features which the operating department controls to a more or less extent, and through study of which it can perhaps aid in reducing fuel consumption, we might call attention to the following:

LIMITATION OF POWER KEPT IN ACTUAL SERVICE.

We assume that practically the maximum number of engines required to handle business at its height is assigned each division. Good judgment in shopping engines for repairs and in storing them during dull periods is an important item in fuel economy. We do not believe in limiting the number of engines kept in service to a point that might delay freight through lack of power to move it, but while any train or number of trains may be moved with a low rate of fuel consumption when only fuel used in actually moving is considered, yet all fuel consumed by the engines of a division must ultimately be charged against the total train movement of such division, and engines needlessly lying ready for service and consuming fuel in idleness increase the fuel consumption per ton mile above the figure used in actually handling tonnage. If an engine, which when promptly utilized can cover the division with four tons of coal, burns a ton while waiting to be utilized, five tons must be charged against train movement and fuel consumption per ton mile is increased accordingly. The same is true of power held out on road beyond what would be a reasonable time under favorable conditions, when such delay is due to indifferent operative conditions. It is realized that delays are not always chargeable to the operating department, but closer final charges for fuel consumed are to the number of pounds per ton mile used in actually handling train, the greater will be the credit due that department.

In storing engines, we believe in keeping those in service whose mileage comes nearest entitling them to shopping. If poorer engines are stored, the good ones are being worn out during the dull season and when the rush season comes this department is handicapped by having the majority of its power in poor condition. With poor power in use during dull periods, the tendency of such power to break down is not as likely to cause delay to following trains, with accompanying waste of fuel, as in the busy season when trains run closer together.

Credit should be given to the operating department by the fuel economist when it exerts its influence to have maximum amount of power repairs made in dull seasons. Judgment in assignment of different classes of power to sections best suited to each class, or assignment of such variety of power to various sections as the peculiar requirements of such sections demand, is important to fuel economy. While each division operating department may not always obtain the power best suited to its needs, judicious assignment of such power as is at its command to runs best suited to each class, aids in keeping down fuel consumption and brings corresponding credit.

TURNING OF POWER.

Whether in direct charge of turning or not, it is entitled to credit for aid in procurement of betterments that make quick turning possible with accompanying economy in fuel. This calls for good arrangement of trackage to and from yards to turntable, ash-pit, coal-chutes and water tank, and a sufficient and efficient turn-table, ash-pit, coal-chute and water crane arrangement whereby, particularly at busy terminals, a more or less continuous "blocking up" condition is avoided.

YARDS—TERMINAL, INTERMEDIATE AND HUMP.

Yard conditions, terminal and en route, are perhaps the most prolific source of train delays that result in increased fuel consumption. Terminal yards should be large enough to permit prompt entrance of incoming trains and provide for quick movement of the power to the engine terminals. Yards at intermediate points should provide for speedy switching where necessary to pick up or throw out cars and for prompt obtainance of water and fuel when necessary. At large terminals, separate yards for making up trains going in opposite directions, classification tracks in connection with making up, provision for proper storage tracks, cripple tracks of easy access into which bad order cars may be thrown for repairs, which are to be used exclusively for this purpose, and making up tracks, long enough to hold the maximum length of trains hauled, thereby avoiding switching incidental to making up on two tracks, all tend to promptness of train movement and minimizing of fuel consumption. Hump yards are an efficient means of reducing fuel charges in switching service by reducing switching power. Credit is due the operating department for being instrumental in having these installed. Experience is teaching, however, that unless closely watched they not only run up car department costs, but are not as conducive to fuel economy as they might be, due to failure of the yardmasters at some points to see that the cars are not prevented by riders from striking with sufficient force to damage them. This frequently results in delays due to making repairs or throwing out badly damaged cars and is believed to be a material cause of break-in-twos en route, due to damage done to the drawbar rigging by permitting such serious impacts, with increased fuel consumption due to such delays. While giving credit for betterments promoting prompt train movement and fuel economy, none of the saving gained should be lost by unnecessary carelessness.

LOADING OF THE POWER.

Proper loading of the power as to capacity is important to prompt train movement and fuel consumption. We believe the power should be loaded to not more than 90 per cent. of its maximum capacity under the best conditions and this varied according to weather conditions. Fuel is sacrificed by under-

loading as well as overloading. Where a grade on the division is not sufficient to justify pusher service, if trains were loaded so to make certain they would not stall on such grade they would be underloaded over the rest of the division, causing considerable loss in ton miles and increased fuel consumption per ton mile. Local conditions should be carefully studied to determine the most economical load for the territory. Makeup of trains as regards heavy and light cars is important, as the further from the engine the heavy cars are, more flange friction is increased on curves and the harder the train will pull. Efforts should be made to place heavy cars at head end of train. Judgment, however, should be used in order not to bring about bad braking conditions.

TRAIN INSPECTION.

While train inspection is not usually directly in control of the operating department, it bears such intimate relation to train movement that this department is vitally interested in it. Prompt inspection of trains, providing adequate facilities for such inspections, for making light repairs, for throwing out bad order cars, for inspection and testing of air brakes before the road engine is attached, or arrangements for quick test after it is attached, are of direct benefit to it, and incidentally to fuel economy.

BLOCK SIGNALS.

Where block signals are in use, their location so they can be seen a reasonable distance away from the approaching train is important. So, also, is proper maintenance of lights thereon, their size and the focus of the lens. Being required to reduce speed on account of not being able to see the signal until almost at it is not an uncommon cause of slow movement and, therefore, not conducive to fuel economy. In congested districts, where stops are likely to be frequent, the location of signals with a view to good starting ground, is of importance. Automatic block signals are decided improvements over mechanical or hand-thrown signals, on account of being closer together, enabling an inferior train to occupy the main track closer to the time of a superior train and to start out closer behind a superior train, thus bringing about more prompt train movement and less delay in allowing superior trains to pass, resulting in fuel saving.

TRAIN DESPATCHING AND HANDLING OF TRAIN ORDERS EN ROUTE.

Handling train orders from towers without requiring the train to be brought to a standstill is important to prompt movement. Handing orders to the crew in passing at low speeds by means of hoops and staffs is in successful operation on several roads, and credit for the accompanying savings in fuel is due the operating departments that adopt it. In automatic block territory on ascending grades, heavily loaded trains should be allowed to proceed under caution instead of coming to full stop. In manual block territory on ascending grades, caution cards should be handed on by hoops instead of stopping the train. The use of telephone boxes at outlying points for the purpose of directing crews with reference to train movement is also a distinct aid and source of credit to the operating department. Utilizing the track against the current of traffic can be frequently done on double track roads to good advantage.

POOLED OR ASSIGNED POWER.

Whether best to pool the power or assign each engine to a regular crew has an influence on fuel consumption. Admitting a regular assigned engine is given more attention by the engine crew, that it will get out on time more frequently, and with a good engine crew may perhaps cost less for maintenance, yet with the growing tendency to take the responsibility of doing work on the engines from the engine crew and placing it on the shop, the advantages of assigned engines are becoming fewer. The sixteen-hour law makes it practically impossible for an engine crew to follow an engine unless it is held a long time at the terminals, which cannot be thought of when the yards are congested. If the engine is not held, the engine crew that brought it in may not see it again for a week, which practically places the engine in pooled service. If men could, as formerly, follow their engine with whatever rest they themselves considered sufficient, the assigned engine would be ideal. If the assigned engine is in better condition, it is only because the engine crew is continually reporting work and following it up. If engineers on pooled engines were educated to take the same interest in promptly and intelligently reporting work on every engine brought to the terminal and were held to strict accountability for reporting all defects, and the shops were required to do the work reported, there would be little, if any, advantage in assigned engines over pooled engines. While every railroad has its portion of indifferent engineers, the pooled engine will occasionally, even now, get the care of the interested engineer. It is a well-known fact that the same volume of business can be handled with less number of pooled engines than assigned engines, which should result in a corresponding lower total fuel consumption.

CONCLUSIONS.

The measure of credit due to the operating department for low fuel consumption per ton mile lies in the progressiveness, strenuousness and the persevering continuity of its efforts to bring about perfect operating conditions and despatching methods in its territory. With railroads hampered, as they are today, by restrictive laws and rate-making legislatures and commissions, the recognized successful railroad men are those who can increase the company's net income by limiting the amount of its financial outgo, and in so far as the efforts of the operating department are successful in bringing about conditions that cut down the fuel consumption per ton mile, it need have no fear of not receiving the full credit thereof.

Committee: M. J. Howley, chairman, T. B. Mowen, J. C. Petty, J. W. Nutting, G. H. Travis, and P. J. Miller.

DISCUSSION.

Many different ways in which fuel could be saved by care on the part of the operating department were mentioned in the discussion. It was pointed out that many of the lower officers of the operating department did not realize this and that if they were shown clearly exactly how their actions affected the coal pile different results might be obtained. There is no lack of interest on their part but a lack of knowledge.

Forgetfulness in recalling slow orders by the roadmaster or bridge department is frequently the cause of much wasted coal. Several members seconded the report of the committee where it mentioned the importance of the location of water tanks, switches and signals in relation to grades. Lights on signals and switches which were not large enough or out of focus were also mentioned as frequent causes for slow downs which required an unnecessary increase in the fuel consumption.

The very large and entirely unnecessary consumption of fuel caused by a locomotive ordered but waiting for its train is probably where the operating department has its greatest opportunity for fuel saving. Two hours is ample time for the roundhouse to prepare an engine for its train, and any loss of fuel due to waiting should be debited to the operating department. In the same connection the anxiety of the yardmaster or superintendent to quickly get the train out of the yard as soon as the engine is attached to it, is responsible for working the engine so hard for the first mile or two that the fire is put in a very bad condition and a failure further down the line is invited in addition to the direct loss of fuel at the time.

While it is generally admitted that the despatcher will make every effort to keep the trains moving, it was believed that closer care by all other operating and road men to avoid delays would decrease the fuel consumption. It was believed by some members that over 30 per cent. of the fuel burned on a trip was

required while the engine was standing still. The Interstate Commerce Commission reports show that a speed of but 20 miles per day is made by all freight trains. A faster movement of trains would tune up the employees in freight service to faster work. The trainmen in passenger service were used as an example of this result. As a flagrant example of waste of fuel due to the operating department not using an engine as quickly as it was ready, a test had recently shown that at one terminal 81 per cent. as much fuel was used by the locomotive before starting out as was required to cover the whole division. In this connection it was pointed out that all of the fuel saving devices on the locomotive are only of value when the engine is in operation.

Although it was understood that the character of the freight often governs the size of the train, it was believed that greater care in arranging the tonnage in order to give a full sized train to the locomotive, and at the same time not overloading it, would have a distinct effect on the coal pile. Examples of where locomotives were run over two or more divisions continuously with only cleaning the ashpan and taking coal and water at the intermediate terminal, were mentioned. In one case a run of 286 miles was made by a freight engine with but seven minutes delay at the intermediate terminal.

It was advised that when matters of this kind are being taken up with the operating department it is advisable to have all details immediately at hand. Generalities will not bring results and give the co-operation which really spells success. It is the practice on one road to issue each month from the vice-president's office a sheet giving the fuel consumption per hundred ton-miles and per car-mile for each division. This sheet is arranged for ready comparison between the divisions and has had a very material effect on the operating department in regard to reducing coal consumption.

MR. TOLLERTON'S ADDRESS.

W. J. Tollerton, general superintendent of motive power, Rock Island Lines, in addressing the convention, stated that traveling engineers should remember that the necessity for using discipline is, in many cases, an indication of lack of proper instruction. Education is the proper means of obtaining the best work from an engine crew and the better it is, the less necessity there will be for disciplinary action. The educational work should start with the fireman when he is first hired and be most thorough at the beginning. He recommended that meetings be held with firemen and engineers, committees appointed and papers prepared and discussed. A box in the roundhouse where suggestions from engineers could be deposited was also mentioned as a good practice.

Vague engineers' work reports were mentioned as a point for possible improvement. Such indefinite reports are needlessly expensive. Of the total cost of locomotive operation, fuel consumes 42 per cent., but repairs require 24 per cent., and more explicit and carefully made engineer's reports will reduce the latter figure considerably. Careful attention to prevent overloaded tenders, and also to seeing that the water glass shields are properly applied and maintained were mentioned as two features in which the traveling engineer can assist materially in the safety movement. It was pointed out that the cost of personal injuries and fire are a complete loss to a railroad company.

ELIMINATION OF BLACK SMOKE FROM LOCOMOTIVES

BY MARTIN WHELAN.

We all agree that smoke escaping from a locomotive stack is a waste and the greater the volume of smoke the greater the loss. The emission of black smoke is a sure indication of imperfect combustion. It is also an infallible sign that there is some condition existing in the firebox that is detrimental to combustion, and the question is: Could that condition have been averted? In other words: Can the emission of black smoke from the stack of a locomotive burning bituminous coal, be prevented, and how can it be done?

It can be done, and locomotives working in all kinds of service, both heavy and light, and frequently dragging trains up a long grade at slow speed, and in ten hours' work can be fired so that they will not make No. 2 smoke of the Roberts chart.

The most effective device for preventing smoke is a number of combustion tubes used in conjunction with steam jets. These tubes are located in the side sheets or back head of a boiler. The number in the side sheets usually varies from four to seven on each side. They are 2 in. in diameter and are applied by removing the fifth or sixth staybolt above the mud ring and in enlarging the hole to fit the 2 in. tube. Where the tubes are located in the back head they are usually placed above the fire door. The object is to admit air above the fire and to mix it with the gases as they escape from the burning coal. The steam jets are connected by ½ in. pipe with ⅜ in. nipple entering the tube. Some roads have the nipple opening just flush with the outside sheet, and others go to the other extreme and extend it in almost to the inside sheet. The reason for this difference is that when placed outside the noise is very annoying and it requires constant watching to get the engine crews to use them. The noise is greatly reduced when they are extended inside. The tubes located in the back head are also effective, but the noise is objectionable.

The next requirement is the blower connection with a 1¼ in. pipe extending from the fountain to the smokebox. The multiple blowers are preferable because they are almost noiseless, but objectionable because the small openings soon become filled with dirt. The double tip blower is the most serviceable and is generally used on that account. The blower pipe should have a quick-acting auxiliary valve located so that the fireman can reach it easily from either the deck or the seat box. The steam jet connection is usually made to the blower pipe, either above or below the auxiliary blower valve (preferably above), so that the steam jets can be controlled independent of the blower, as there are times when the engine is using steam that it is found necessary to use the jet and not use the blower. The valve which controls the steam jet should be located close to the auxiliary blower valve.

The brick arch is a great help when using steam, but in my opinion is of little benefit when the engine is shut off, unless the arch is sealed against the flue sheet. When this is done it will pocket the smoke and gases and prove a great benefit. There is the objection of cinders and dirt accumulating on top of it, but I find that after two weeks' service between washouts the amount of cinders will seldom cover more than two or three rows of flues. On freight and passenger engines there is sometimes an opening left between the flue sheet and arch, as they are almost continually using steam, and if properly handled by the crew, will make no smoke.

Another device that is frequently brought in discussions on smoke elimination is the mechanical stoker. Although I doubt that the question of smoke elimination was primarily considered by the designers of any of the locomotive stokers, still I believe it should be considered, as smoke from locomotives has been declared by a law a nuisance in many places, and while the absence of smoke does not always indicate proper combustion the presence of it does indicate improper conditions. I have seen several of these stokers tested, but with one exception they made a great deal of smoke. The only one that I know anything of that is smokeless is an underfeed stoker used on the Pennsylvania Railway and known as the Crawford stoker. I have seen this stoker in all kinds of service and know it is a success as a smoke eliminator.

Co-operation on the part of the engine crew is of the greatest

importance. Without it mechanical devices are a failure. The most effective preventer of black smoke is the man behind the scoop. A fireman who has a fair knowledge of the principles of combustion and makes use of that knowledge will make a better showing on smoke elimination than a disinterested one with all the known devices or even the best grades of coal. Experts may spend time and money figuring on the best methods, etc., but all devices are more or less dependent on the human element. None are foolproof, and we are brought down to the conclusion that the men on the locomotives are the principal factors and therefore it becomes necessary to work along the lines of first getting them interested and then educating them. Why are firemen not interested and what can be done to overcome this lack of interest, is the great problem of today, and until it is solved, smoke elimination is a difficult proposition. We all recognize that the firemen of today have not the advantages of the regular engine or the regular engineer. That has been taken from them. Arrangements have been made to take care of the pooled engines, but we have failed to arrange for the changed conditions that the pooled engines have forced on the firemen. All progressive railroads maintain apprentice schools for the purpose of educating the mechanics, but how many pay any attention to the education of the firemen? The mechanical apprentice, after serving four years, still continues under the eyes of a foreman, whereas the fireman after three years spent feeding coal into a firebox is considered competent to assume the responsibility of managing a locomotive on a busy railroad. The apprentice just out of his time may leave the railroad that educated him and never return, whereas the promoted fireman usually remains during his life, and once he becomes an engineer he has no foreman immediately over him in his daily work, but instead he becomes a foreman himself.

Daily observation has convinced me that the engine crew is the main factor. The devices only assist in proportion to the degree of intelligence used by the engine crew. In a district like ours where the smoke question is followed closely, we are able to fully appreciate the value of it over the conditions that existed before the question was given any consideration. There is considerable saving in fuel owing to the fact that the men are educated to put in small quantities of coal at a time; as a result of this the fire is kept in better condition, there is much less work cleaning it on the ash pit, less trouble with tubes leaking, fewer engine failures, and finally when these firemen are promoted to road service we hear less of engines not steaming on account of poor coal. In the Cleveland district the crews are disciplined for violations where such violations are the results of carelessness. Both engineer and fireman are held equally responsible. For the first offense they are warned, and if they still continue to disregard the instructions they are suspended, usually for ten days.

In conclusion I wish to state that if engines are equipped with the ordinary devices for the prevention of smoke and the engine crews are properly instructed as to their use and the proper method of firing a locomotive, there will be but little cause for complaint on account of objectionable smoke.

DISCUSSION.

Ample testimony was given that proper instruction and supervision of the engine crew will do very much to reduce the amount of black smoke. This should begin when the fireman has first entered the service. In fact, some members believe that the fireman should be given a more thorough understanding of his work before he is hired at all and given to understand exactly what will be required of him in the matter of making smoke. Difficulty is found in getting the engine crews to properly follow instructions and it is recommended that an inspector whose sole duty it would be to supervise the crews in this particular, could make himself valuable. One member went so far as to say that smoke could be prevented in any service if the proper care and equipment were provided.

It is generally admitted that the roundhouse is the most flagrant offender. Probably 70 per cent. of the smoke made in roundhouses could be eliminated with the proper supervision and equipment, was the opinion of one of the speakers. Smoke washers are being tried with some success on the Lake Shore & Michigan Southern. These consist of a large duct running around the house into which all smoke from the locomotives is drawn by a suction fan and then discharged through a vat of water which dissolves most of the obnoxious gases and entrains all of the free carbon.

Both the brick arch and the superheater were mentioned as aiding in improving the situation. This is especially true on switch engines. Sufficient air opening to the ash pan is a very important feature in reducing the smoke when the engine is working hard and in some cases it was found impossible to have successful firing except when the fire door is open.

ADVANTAGES OF THE BRICK ARCH

BY LE GRAND PARISH.

The general introduction of the brick arch in the past few years has been brought about by the necessity for increased boiler power and sustained steam pressure. The other incidental advantages, which, in themselves, are large, are subordinate to the necessity for increased power per pound of metal.

The locomotive builders were among the first to advocate the application of the brick arch and superheater, which are referred to by them as fuel-saving devices. They recognized the fact that, where the weight on drivers had reached the maximum, increased power must come from sustained steam pressure. These, as well as any other devices which will aid in bringing about this result, are receiving earnest attention by mechanical and operating officers. Important improvements are being made in the form and application of brick arches and arch tubes, as is evidenced by the recent combination of the sectional arch on tubes and the Gaines furnace. These improvements are the inventions of men in railroad service who are trying to improve the steaming capacity of the boiler. The long firebox with a suitable combustion chamber, shorter flues in some cases, improved front ends, improved grates and better air admission in the ash-pan have given surprising results. Important improvements in exhaust nozzles and exhaust passages in the saddle have also been developed in the past few years. All of these things are essential to the successful operation of the locomotive, and every detail that will in any way result in the increased capacity of the boiler is imperative today.

One result of the application of arches is to reveal weaknesses in other factors affecting combustion. It is frequently necessary to give immediate attention to the admission of air through the grates. This is usually done by cutting down the nozzle, whereas the fault lies in the ash-pan. The fire must have air, and when it is considered that it is necessary at times to use twenty-five tons of free air per hour (or a volume equal to 350 box-carfuls of air), we better appreciate the problem which confronts us when this has to be drawn in by the exhaust nozzle. The more difficulty experienced in getting air into the ash-pan, the more back pressure we produce in the cylinders. The speed of the air entering the coal on the grates when burning one hundred pounds of coal per square foot of grate per hour is approximately sixteen miles per hour. Its velocity is increased after passing through the fire on account of the increase in volume due to increase in temperature. The speed of the gas entering the flues would increase to approximately 180 miles per hour on a locomotive with seventy square feet of grate and eight and one-half square feet of flue opening, such as is found on our large Mikados. This will give a fair idea of the difficulty in burning the gases before they escape. The arch, acting as a baffle wall, retards the gas only to a limited extent, but long enough, however, to give a better mixture of the air and gas and greatly improve the combustion.

It is a well-known fact that the length of the flame-way is

the all-important factor, because the gas must have sufficient travel to complete its series of explosions before it enters the flues.

The fact that the value of the fire-box heating surface is seven times the value of the same amount of flue heating surface was brought out in the Jacobs-Shupert fire-box tests conducted by Dean Goss, at Coatsville. The long box equipped with a sectional arch, or with the Gaines combustion chamber, insures the proper distribution of heat over the fire-box sheets. The longer fire-box is a protection to the flues to just the extent that the combustion is more complete. The cold air from the door has a longer travel, and, naturally, absorbs more heat.

Another important matter which must receive constant attention is the care of the arch tubes. No trouble whatever is experienced from scale when a mechanical cleaner is used to cut it out of the tubes at each boiler washout. This practice is now quite general and should be universal.

There is no difficulty experienced from bad water where the tubes are properly cleaned. Washing will not answer the purpose—the scale must be cut out. This practice has been in effect on all water tube boilers of the stationary type for years, and the water tube boiler is in common use in all bad water districts. It was the successful use of the mechanical cleaner in water tube boilers that brought about its general use in locomotive boilers and made the use of the arch tube a practical success. The flow of the water through the tube is reduced very rapidly as the scale increases, due to the rough surface of the interior of the tube.

The value of the arch tube as the means of better water circulation has not received the attention it deserves. The history of the arch tube shows clearly that it was originally applied as a means of support for the arch, and its value as a circulation device was not seriously considered. Later it was accepted as having some value. In this respect today its value is of decided importance. The problem in good steaming is to utilize the full value of the heating surface. Flues which lie below the center line of the boiler have difficulty in getting rid of the heat. The only way that this may be accomplished is by getting a more rapid circulation of water in the bottom of the boiler. This will be better understood when it is known that, when the boiler is working up to its capacity, four 3-in. arch tubes will circulate fully 30,000 gallons of water per hour, when the discharge end of the arch tube is designed to discharge at the surface of the water. The boiler of a consolidation engine of modern type ordinarily contains about 3,500 gallons of water. From this you will see that the circulation is very rapid.

The 3-in. arch tube (2⅝ in. internal diameter) in common use today is the minimum size that should be used, as the diameter of the tube has a direct relation to the amount of water circulated. If the tube were reduced to one inch, it is quite probable there would be no circulation except that required to replace the water evaporated into steam in the tube. In other words, the tube would flash the water into steam of a high temperature, and practically no water would be carried out with the steam. It is quite possible that the future will see the use of circulating tubes of greater diameter than three inches. A proper design should give all the additional benefits to steaming that are obtained in water tube boilers of the stationary type.

We expect to see a decided improvement in locomotive boilers due to better circulation. More rapid circulation of water on the heated surfaces will increase the evaporation on account of the rapid replacement of the hot water with colder water. The scouring effect of the water will take up and carry away the heat, allowing the colder water to come into contact with the heated surfaces. It will be necessary to give attention to this feature if we expect to secure the benefit from a higher velocity of gases over the heated surfaces. Heat will flow rapidly through a sheet when there is cold water on one side, and will flow less and less rapidly as the temperature of the water increases. This may be illustrated by the trouble which was experienced with bottom combustion chamber sheets before arch tubes were applied. The over-heating of the sheets was due to the fact that there was no circulation to take away the heat.

Improved steaming means better fire-boxes, and this means more satisfactory operation. The relation between the air supply, the coal and the arch is so intimate that they must be considered together.

Free access of air into the ash-pan is very important. The cases are rare where too much air is admitted through the grates when they are properly covered.

The important improvements in the future must come from improvements in nozzles or draft; improvements in grates and air supply; improvements in water circulation, and, last but not least, the development of longer combustion chambers.

The theory of a combustion chamber as applied to a locomotive is quite simple. The fixed carbon burning on the grates distills the volatile matter which is below the temperature of the heat which produced it. By adding the proper amount of heated air to the volatile matter as it passes over into the combustion chamber, the volatile matter is ignited and the temperature in the combustion chamber raised above the temperature over the fuel bed. The complete burning of the volatile matter depends upon the proper mixture of air and the length of the combustion chamber.

Anything mechanical that will aid in making a better mixture of the gas and air will improve combustion. The long combustion chamber increases the distance the gas has to travel on its rapid race to the flues, and gives more time for the gas and air to unite in the proper mixture and complete the series of gas reactions, or explosions, before they reach the flue-sheet.

Improvements in the locomotive have been made so rapidly that it is difficult to realize the importance of keeping up with the development. More expert supervision is necessary in order that proper results may be obtained, and the burden of this expert supervision rests on the members of this association. The success of any device, no matter how small, depends upon the information which the manufacturer is able to obtain from his own experts and the experts having charge of the device on the railroads. We are, therefore, mutually interested in the highest development of the service. The rapid development has brought about the necessity for more expert supervision, and the staff of the manufacturer is being drawn from the ranks of railway service and is made up almost wholly of men who specialize in the work for which their railroad experience has fitted them.

It has been stated at one of your meetings that "the arch is the best device for instructing firemen how to fire properly." This statement should receive the attention it deserves. The arch does not admit of using an excessively heavy fire; therefore, the fireman does not have to be instructed on this important factor.

The value of the brick arch as a smoke preventive is too well known to dwell on the subject here. The cost of the arch is overshadowed by the fuel saving, and the maintenance cost can be kept very low with proper supervision and by having sufficient material on hand at all times to make the necessary and proper renewals promptly. Failure to make these renewals at the proper time often necessitates a complete removal of the arch. If the arch is of value, it should be maintained in 100 per cent. perfect condition all the time.

The whole subject of the brick arch is tied up so closely with the question of proper drafting that it is not wise to apply an arch without full knowledge of its relation to the grates and exhaust nozzle.

DISCUSSION.

F. F. Gaines, superintendent of motive power, Central of Georgia Railway, gave a most interesting and instructive talk on this subject. His remarks in part follow:

While I do not want to bring any chemistry of combustion into the discussion, one of the gentlemen remarked something about the necessary temperature of the air brought into the firebox to complete combustion. If you are going to produce carbon dioxide you will find, on looking up the various books on the subject, you will have to have a fairly high temperature. In other words, CO will not combine with oxygen to make CO_2 unless the temperature is very high.

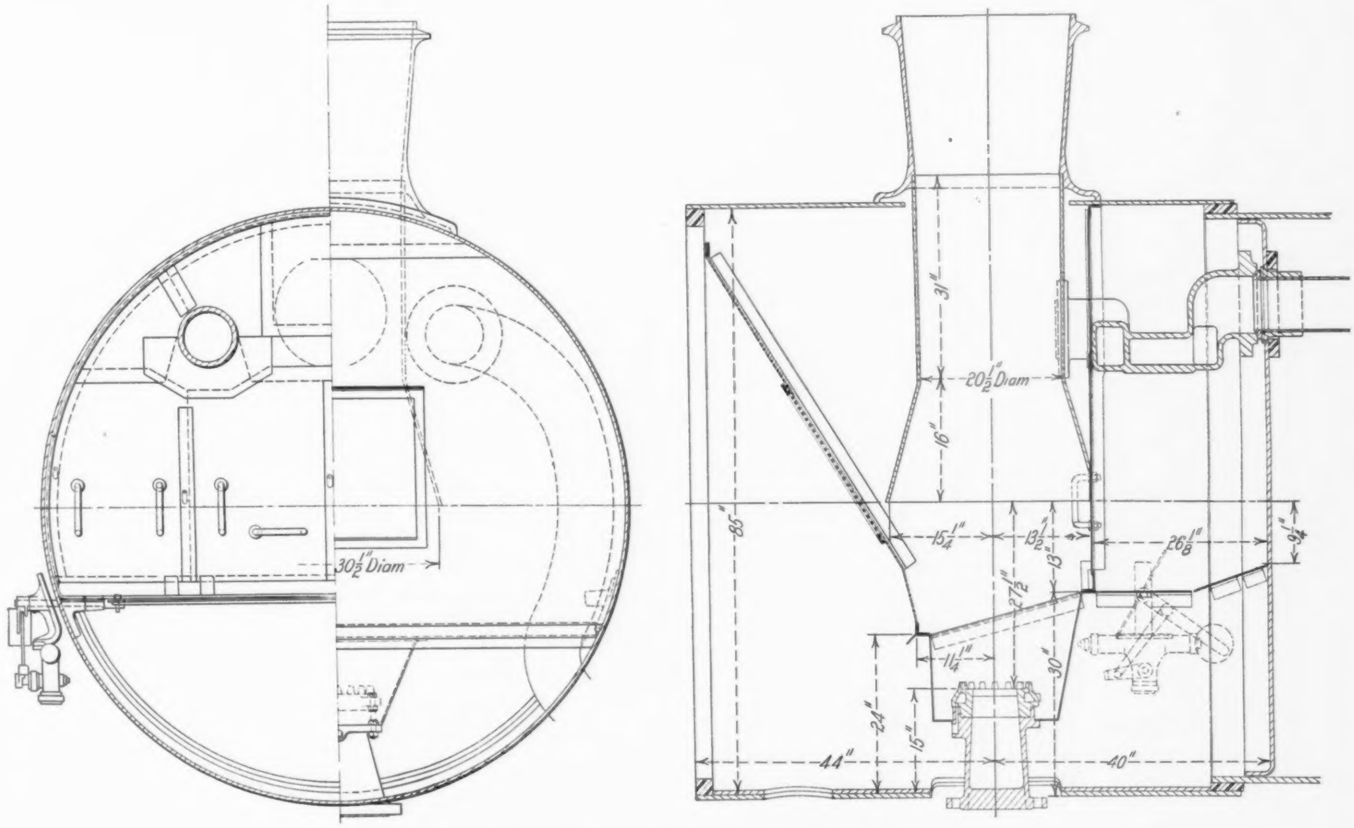
There is another thing that has been developed recently about admitting air to the top of the fire. The report on the series of experiments made by the Pennsylvania in their testing plant at Altoona, was presented at the Master Mechanics' association convention. They found very clearly there that if you force a boiler beyond a certain point in order to get sufficient air to complete combustion you have to open the fire doors and allow air to be introduced in that manner. In other words, they could not get enough oxygen in the box through the fuel bed, without opening the doors. Of course, that is contrary to all accepted practice in firing, as we understand it. Nevertheless, the fact remains, in order to get the maximum evaporation out of that engine they had to introduce large quantities of air on the top of the fire.

If you use a mechanical cleaner and good sized tube there is very little trouble with the arch tubes, even in bad water districts. We have found since using mechanical cleaners we have almost no trouble at all, and where we previously had a rule that they must be removed after a certain length of time, I have gradually been increasing that limit until I think we have gone to a period of a year now before removing arch tubes.

Another thing I found in experimenting with arch tubes, and that is that it is not always wise to use a heavy tube. We originally used to use a heavy tube, but when we cut it down to .15 in. thickness we found that apparently there is a better circulation of the water, probably due to the fact that the thinner tube does more evaporating and we have less trouble with the tubes themselves.

There is another point that has been brought up in the introduction of this paper that is very interesting, and that is the proper drafting of the engine. The experiments I have made, and they have been extending over a period of years, show that the maximum results with an arch require a low nozzle, and I do not believe you can get it too low. What I mean by that is this: if you have the old style inside steam pipes they, of course, obstruct a great deal of your area through the front end and you have got to raise your nozzle high enough to give opening enough for your gases to go out underneath, on account of the steam pipes obstructing the area. But if you have the outside steam pipes, as you have on a majority of superheater engines today, you can afford to bring the nozzle very much lower.

I have recently experimented along these lines and have nozzles on large size Mikado locomotives, that are only 15 in. high, and I find the lower I go the better results I get. Our present design is shown in the illustrations. All our road foremen and our master mechanics were rather against the idea when we started out, but I think they are now all converted.



Front End with Low Nozzle; Central of Georgia.

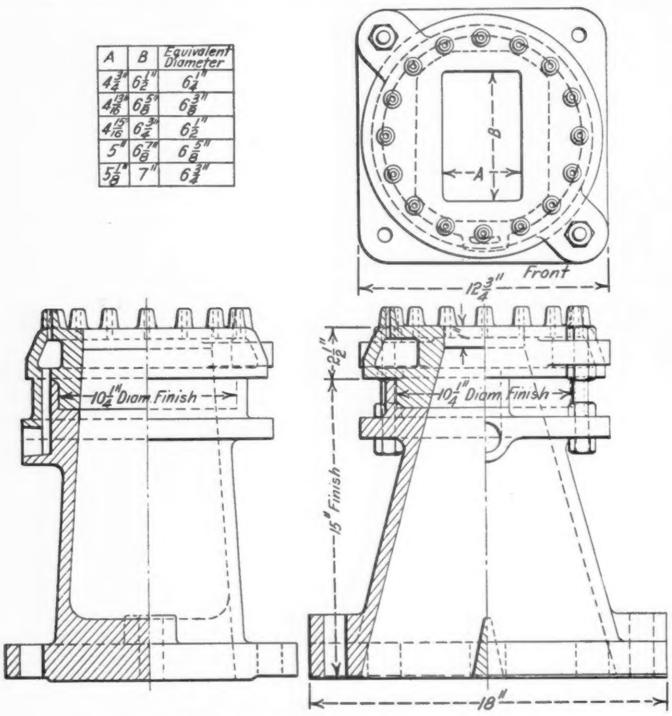
In connection with that, I want to call your attention once more to the series of tests made by the Pennsylvania, in which they demonstrated quite thoroughly that to properly fill a stack the old form of circular nozzle would not answer; in other words, that the nozzle must be oblong or rectangular in character. I have been carrying on some experiments along this line and I am thoroughly in accord with the results obtained. I find we fill our stacks much better with the oblong nozzle than we ever did with the round nozzle.

We find that with a combustion chamber and arch combination we have superheater engines that have been running for 15 or 16 months and we have yet to get the first report in the roundhouse to have one of the large superheater tubes blown on account of being stopped up. I think you will all agree with me that is quite a remarkable record. When we first got them we blew them every trip, and then we gradually reduced until I sup-

pose we blow them not more than once or twice a month now, just as a matter of form.

A saving of from 5 to 10 per cent. in the amount of fuel burned was reported by a number of members who were using the brick arch. In most cases it is advisable to have the arch tight against the throat sheet although instances were mentioned where it was desired to keep a heavier fire and several of the bricks on the lower rows were omitted. Very little difficulty was reported in connection with the arch tubes failing although the necessity of seeing that these tubes are properly cleaned and kept clean was generally admitted. The value of the arch as a safety device in case of a burst boiler tube was mentioned. On the Lake Shore & Michigan Southern there has been but one arch tube failure in three years and three months service. As a general thing the engineers and firemen were found to strongly favor the use of the arch.

The discussion was expanded to include firing methods. Examples of where a very heavy and thick fire had proven successful from every standpoint was mentioned but it finally appeared that the almost universal sentiment of the members was in favor of light and level firing with a light body of fire in the box.



A	B	Equivalent Diameter
$4\frac{3}{4}''$	$6\frac{1}{2}''$	$6\frac{1}{4}''$
$4\frac{13}{16}''$	$6\frac{5}{8}''$	$6\frac{3}{8}''$
$4\frac{15}{16}''$	$6\frac{3}{4}''$	$6\frac{1}{2}''$
$5''$	$6\frac{7}{8}''$	$6\frac{5}{8}''$
$5\frac{1}{8}''$	$7''$	$6\frac{3}{4}''$

Rectangular Nozzle on the Central of Georgia.

Comparative tests of both schemes were mentioned by some of the members, in each case showing that the light fire and light feeding were by far the most economical.

Mr. Gaines stated that when first starting his design of locomotive furnace he had the idea of obtaining a large firebox volume. This, however, he discovered after longer experience, was not the proper idea and what was really needed is a long flame way. In this connection Mr. Gaines used a most expressive term, *viz.*, "conversational heating surface," meaning that it is by no means the total amount of heating surface that indicates the capacity of a boiler but its proper arrangement and not infrequently a boiler which has a larger amount of surface is by no means as good a steam producer as one with much less surface properly arranged.

MR. MACBAIN'S ADDRESS.

D. R. MacBain, superintendent of motive power, Lake Shore & Michigan Southern, spoke in part as follows:

There is an impression on the part of many that you must fill a smoke stack with the exhaust jet of an engine in order to have a proper steaming engine. There never was a greater fallacy, and if you will all just stop to think for a moment what a steam jet from a 1¼ in. pipe going up through a stack does by way of stimulating your fire to make it burn, you will readily realize that it is not necessary to have a steam jet the full size of the smoke stack.

We found a great deal of our trouble on some of our engines which have a little short smoke stack outside and an extension bell inside. It came from the fact that the exhaust struck this thing on one side or the other. The engines all cross-fired to a certain extent and they scoured up the side of the stack. The effect of that was on passenger engines that there was just one notch you could work your engine in, just so much throttle. In fact, you could evaporate just so much water and keep your fire burning nice, and when you began to crowd beyond that point the fire would begin to redden up and the steam pressure would drop correspondingly. What we did, was to provide a big enough smoke stack, and a means for sending the steam jet straight up through the center of the stack. The effect of this was to reduce the steam failures 90 per cent. It is now the rarest thing for us to have a steam failure on anything.

We have now about 350 superheater locomotives running and their use is carrying with it some evils that we did not look for at the start. The one I have particular reference to is the carrying of the water. When we had saturated steam engines the engineer never thought of carrying the water out of sight in the glass or even up at the top of the glass. But on the superheater locomotives the engineers say there is one thing sure, you can carry more water than you used to. Of course, men informed on the superheater proposition will understand just why that is so. As a matter of fact, the engine foams just the same as she ever did, primes just the same, but the water that goes over into the dry pipe and out into the units is re-evaporated so that you are using the superheater unit as an evaporating proposition pure and simple, instead of for the purpose for which it was intended. This is something that the road foremen ought to give careful attention, and get the engineers and firemen to understand that they are hurting themselves when they are taking advantage of the fact that they can carry the water higher than they did before.

I do not know any of the important roads in this country now that are not using the brick arch. As regards location, opinion is divided on that and I believe it always will be. We have two districts, one east of Toledo and one west of Toledo, and the master mechanic west of Toledo would not listen to anything else except keeping his brick arch down next to the sheet, while the master mechanic east of Toledo has the opposite view and all his staff with him. He believes they ought to carry the brick arch back 4 in. from the sheet. Whether it is due to the class of coal we use I do not know, but we are getting good results on both divisions. Equally good, I might say.

We have had some very interesting experiments with the brick arch in smoke prevention in the past three years. We had some engines switching in the Cleveland district that did nothing but handle passenger cars around the station. There was no continuous effort. There was no very hot fire at any time, and we thought we could go a long way in putting a lot of brick in that firebox without getting into trouble, and we covered the whole firebox with brick first, and then took out the two back corner bricks, and ran that engine three or four months. She is the best smoke consumer in the world. There are only two 13 in. x 10 in. holes in the back of the smoke box. I have changed that a little since. We now have three holes. On a switch engine doing short work, where there is no continuous effort and the fire will not be stimulated to an intensely high degree for any length of time, that is a proper installation of brick arch. If you want to save trouble with smoke put all the brick you can in there; just leave an area a little greater than your smoke stack, and you will get good results.

The superheater on switching engines has done more than

was never anticipated for it by the promoters of the device. While you do not get at any time any perceptible degree of superheat above the temperature of the steam as it leaves the boiler, you do, in a properly designed equipment, eliminate practically all of the condensation which takes place between there and the cylinder, which makes a big saving, not only in economy in fuel, but in a corresponding decrease in the amount of smoke that goes out. The Lake Shore is putting it on all standard switch power at the present time. We are equipping 50 engines this year.

I used to be a very strong advocate of the petticoat pipe, but I want to say to all that there is no necessity for a petticoat pipe in the locomotive. We have not a petticoat pipe on a Lake Shore engine, switch engine or any kind, and have not had for the past five years. We are getting along splendidly. In place of the petticoat pipe make your exhaust pass up through the center of the smoke stack. That is all that needs to be done to get a good draft.

CARE OF LOCOMOTIVE BRAKE EQUIPMENT

The committee concludes that its paper was intended to deal with such failures of this equipment as might occur while out on the road, and has proceeded under that assumption.

The federal law requires that not less than 85 per cent. of the cars in a train (engine and tender being counted as two cars) shall have air brakes in use by the engineer; also that "all power-braked cars in every such train, which are associated with the said 85 per cent., shall have their brakes so used and operated." Obviously, the foregoing plainly implies brakes that are efficient. While this law makes no provision by which, in the event of any failure that prevents use of the train brakes, the train may be moved beyond the point where this occurred, the fact that this would seriously block traffic has prevented objections to moving such a train carefully and under full control of hand brakes to the next side track, but beyond which, we understand, it may not be taken, with liability of prosecution, until repairs or another locomotive again permit of using the air brakes as required.

This necessarily means that engineers must possess a reasonable knowledge as to how to locate and remedy the causes of the ordinary failures to the locomotive brake equipment that may be susceptible of remedy, in order to prevent delays and the possible tying up of the trains. The engineer who can correctly diagnose the cause of such troubles and apply such remedy as will permit him to proceed within the law and without serious delay to his run, is bound to stand high in the good opinion of the officials of his road.

While a good knowledge of the construction of the air brake equipment and its operation is excellent, a knowledge of what to do in case of trouble with any of its parts is indispensable; more so today than ever, and the teaching of how to render "first aid" to an ailing equipment should form an important part of all air brake instructions.

The air pump, furnishing, as it does, the power that operates the brakes, is naturally the most vital part of the equipment, as its failure to operate means the tying up of the train if out on the road and it cannot be started up again. Its operation is controlled to some extent by the pump governor, which in turn may be responsible for the erratic action or complete stoppage of the pump, and it is therefore particularly important that the engineer should be familiar with the possible defects that can occur in either of these parts, how the governor defects may act on the pump and the means that can be used to perhaps overcome the troubles.

[Most of the probable failures of the equipment on the locomotive were mentioned in the report and the proper procedure for correction or temporary repairs was given.—Editor.]

Committee: H. A. Flynn, chairman, T. F. Lyons, F. B. Farmer, L. W. Sawyer, C. M. Kidd.

DISCUSSION.

The general opinion of most of the members was that an engineer should make all efforts possible to repair any breakdown of the air brake apparatus on the road. He should first notify the despatcher or superintendent, giving an estimate of the length of time that he will be delayed and also information as to probability of his requiring help. It was, of course, admitted that every effort should be made to prevent any breakdowns on the road and that the greatest care should be given to the repairs and inspection of the air brake apparatus before the locomotive left the roundhouse. A good plan is to have the air brake inspector make a minute and thorough inspection of the whole apparatus at each boiler washout. Where this plan is followed very little difficulty has been found in keeping the apparatus in good condition.

One of the members explained how many of the breakdowns which frequently cause the locomotive to give up its train can be repaired by a little ingenuity on the part of the enginemen.

On the Erie it is the custom to have a general mechanical staff meeting every ninety days and a staff meeting of the road foremen and superintendents of locomotive operation at the same interval. These meetings last several days. One day is given up to air brake discussion and an expert is invited to address the meeting and answer the questions of the members. Most excellent results have followed this practice.

It seems to be the general opinion that superheater oil was not suitable for use on the air end of the pump and that where it is used, trouble with broken feed valve packing rings and clogged ports is liable to occur. In connection with lubrication it seems that over-doing it is the cause of the greatest trouble. It is not the amount of oil fed but obtaining the minimum amount at the right time that counts. The location of the pump and other parts on the locomotive in a convenient position was also mentioned as a feature which materially affected the making of repairs on the road.

On some roads it is the practice to repair air pumps on a mileage basis. With this scheme the pumps in the different services are allotted a certain amount of mileage and when it has reached its limit, it is removed and sent to the shop for repairs, irrespective of its condition. After being repaired it is subjected to a most severe test which insures its being in perfect condition when again applied.

There appeared considerable difference of opinion as to the advisability of the engineer taking the pump apart on the road in case of trouble. Most of the members, however, seemed to favor the engineer making such repairs and cleaning such parts as may be stuck and seeing that he obtains proper instructions so as to do this properly and promptly.

REMARKS BY E. W. PRATT.

E. W. Pratt, assistant superintendent of motive power, Chicago & North Western, said that the foundation of the locomotive is not always maintained in as good condition as it should be and that it is very largely up to the traveling engineer to follow the roundhouse foreman and see that the best possible work is done. In this connection he mentioned that the Chicago & North Western now has nearly all of its locomotives assigned to regular crews.

In preparing tonnage rating he believes it is best to try it out in practice first and then make the figures and formulas to suit the conditions as found in practice. He suggested that the members in speaking of tonnage rating and discussing the matter with the operating department should be careful not to seem to be trying to underload the locomotive. There is as much objection to underloaded locomotives as there is to overloading.

W. L. PARK'S ADDRESS.

W. L. Park, vice-president of the Illinois Central, pointed out the change that has been made in the position of traveling engineer in recent years. Formerly this position was a sort of a

pension job for an engineer who had given good service. Now, however, it is very distinctly an indispensable position and requires diplomacy, tact and extensive knowledge.

Mr. Park took this occasion of recognizing the work of the supply men for the benefit of the railroad. He stated that not infrequently their work was of the utmost value and that great credit should be extended to them.

The traveling engineer should act, so far as lay within his power, as a publicity agent for the railroad. Railroads are public property. Their stockholders in a majority of cases are people of small means. All employees should give publicity to the real facts of the case, especially in connection with railway legislation and, so far as lay in their power, effect the trend of such legislation toward sensible laws.

Greater efforts should be made to keep trespassers off the line of road as the deplorable showing of the number of people killed and injured by the railroads is principally due to the presence of trespassers who have no right on the property. More influence of a legal nature should be incited to prevent this.

MONUMENT TO MR. CONGER.

A committee was appointed to confer with a similar committee from the supply men's organization in connection with erecting a monument to C. D. Conger, one of the originators of the Traveling Engineers' Association and its president for the first five years. Inasmuch as Mr. Conger was connected with a supply house for a number of years before his death, it seems fitting that the two associations should co-operate in this work.

SUBJECTS FOR 1914.

The committee on subjects suggested for the next convention, committee reports on smoke abatement, efficient locomotive operation, mechanical stokers, and air brakes, with papers on speed recorders, chemistry of combustion, and tonnage rating.

ELECTION OF OFFICERS.

The following officers were elected for the ensuing year: F. P. Roesch, president; Robert Collett, first vice-president; J. C. Petty, second vice-president; J. W. Hardy, third vice-president; D. Meadows, treasurer, and W. O. Thompson, secretary. The new executive committee is as follows: W. C. Hayes, H. F. Henson, Martin Whelan, W. E. Preston, W. H. Corbett, J. R. Scott.

Chicago received the highest number of votes for the next place of meeting.

RAILROAD SMOKE INSPECTORS' ASSOCIATION OF CHICAGO

According to the United States Bureau of Mines, Chicago stands foremost in the matter of a scientific solution for the smoke problem of large cities. The Smoke Inspection Bureau of that city is composed of 25 inspectors whose chief duties are the inspection of the stationary plants. The inspection of locomotive smoke is looked after by men in the employ of the railroads entering Chicago who co-operate with the city inspector. Each year the city inspection bureau makes a series of observations extending over a period of about two months to determine the progress made by the railroads in the reduction of locomotive smoke. As a means of obtaining concerted action among the railroads in this matter, the General Managers' Association of Chicago appointed a committee, of which H. T. Bentley, principal assistant superintendent of motive power and machinery, Chicago & North Western, is chairman, to investigate the locomotive smoke problem. This committee found that the inspectors in service on the various roads were not able to give the service desired, and in the latter part of 1912 it was decided to pool the services of these men so that wherever they might be it was their duty to inspect the smoke of any locomotive of any road, and make their reports to the local company's smoke inspector and to the General Managers' Association, so that immediate action could be taken. In this way the usefulness of the smoke inspectors was greatly increased. The chief smoke inspectors of each road meet every two weeks and go over the reports submitted during that time, discussing the ways and means of improving conditions and securing uniformity of action. If necessary, a number of inspectors are placed in a territory where the smoke is exceptionally bad to overcome the trouble.

As a means of determining the best possible way in which to reduce smoke from locomotives, the General Managers' Association made a series of tests on various smoke devices; these tests were conducted by the Pennsylvania Railroad on the testing plant at Altoona.* As a result of these experiments it has been recommended to the General Managers' Association that all the locomotives entering Chicago be equipped with the device recommended in the report. From the meeting of the Railway Smoke Inspectors' Association of July 25, it was learned that most of the roads operating in Chicago have already equipped their locomotives with smoke consuming devices, such as steam jets, brick arches, etc.

YEARLY REPORT OF THE CITY SMOKE INSPECTOR OF CHICAGO ON LOCOMOTIVE SMOKE DENSITY.

	Railroad.	Summer 1913— Per cent. Density.	Standing 1912.	Summer 1912— Per cent. Density.
1	A. T. & S. F.	4.73	2	4.75
2	Illinois Northern	6.31	23	17.92
3	Illinois Central	7.43	4	6.98
4	C. & N. W.	7.65	16	12.94
5	C. B. & Q.	7.74	1	3.51
6	L. S. & M. S.	9.49	9	11.55
7	Soo Line	10.86	24	19.18
8	C. M. & St. P.	11.75	6	9.36
9	N. Y. C. & St. L.	11.9	7	10.3
10	B. & O. C. T.	12.14	8	10.53
11	Michigan Central	12.23	5	8.98
12	Chicago Great Western	13.37	3	5.6
13	Baltimore & Ohio	13.4	25	20.92
14	Wabash	14.12	20	14.89
15	C. R. I. & P.	14.66	15	12.85
16	C. & E. I.	14.73	14	12.47
17	C. & O.	14.78	Not listed	.....
18	C. R. & I.	14.94	21	15
19	C. I. & S.	15.12	13	12.18
20	C. I. & L.	15.63	11	12.15
21	C. & A.	16.56	10	11.62
22	Pennsylvania	16.58	19	14.4
23	Grand Trunk	16.62	17	13.08
24	Chicago Junction	17.01	28	24.84
25	C. & W. I.	17.1	12	12.16
26	Belt	18.06	22	16.87
27	E. J. & E.	18.45	29	31
28	Pere Marquette	18.8	18	13.18
29	Erie	20.51	27	21.76
30	I. H. B.	26.22	Not listed	.....
31	South Eastern	28.23	Not listed	.....
32	C. S. Line	29.23	31	40

The results obtained by this joint association are well illustrated by the annual report of the city smoke inspector of Chicago, which is given in the accompanying table. This inspection was made by six of the city's inspectors over a period of 48 days; there were 11,151 observations made during that time. The table clearly shows the way in which the different roads are endeavoring to reduce locomotive smoke. While the biggest improvement over last year was made by the Illinois Northern, which jumped from the twenty-third place last year to the second place this year, the Chicago & North Western deserves a great deal of credit in moving from sixteenth place to fourth place, as that road operates in Chicago very nearly twice as many locomotives as any other road. The value of such an association to Chicago is very great, and the work of the railroad inspectors is greatly appreciated by the City Inspection Bureau.

CORRECTION

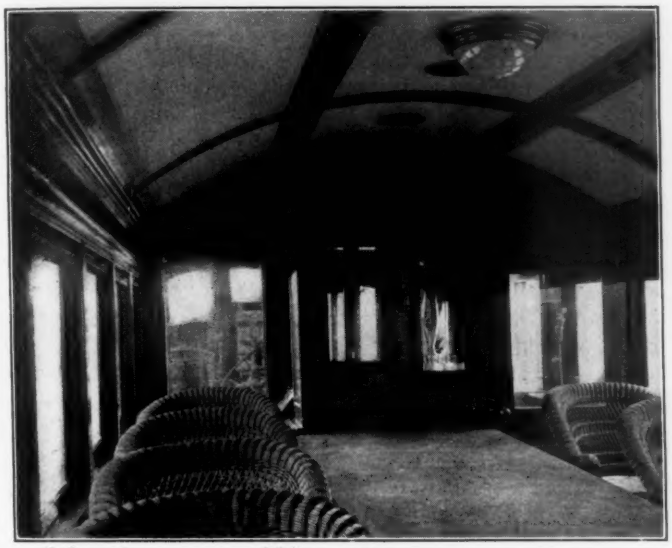
On page 444 of the August issue in the article by C. H. Faris, entitled "Tables for Designing Center Sills" and at the top of the second column, it is stated that $I=I^1-Ad^2$. The minus sign in this formula should be plus. The correct formula is $I=I^1+Ad^2$.

*The results of these tests were presented in a paper before the American Railway Master Mechanics' Association at the recent convention at Atlantic City, and were published in the *Daily Railway Age Gazette* of June 14, on page 1377.

Inspection Locomotive on the Reading

Characterized by a Boiler of Small Size and Large Capacity and a Large Observation Room.

Ordinarily inspection locomotives are built by simply applying a cab or possibly a new boiler and a cab to an old American type locomotive. On the Reading, however, when it was recently necessary to provide three new locomotives of this type it was decided to prepare a design especially for this purpose and the result is a decided improvement in every particular. The space in the observation room is larger, the size of the firebox insures sufficient steam making capacity and the locomotive throughout can be more perfectly balanced, making it easier riding and capable of higher speeds.



Interior of Observation Room Looking Toward the Rear.

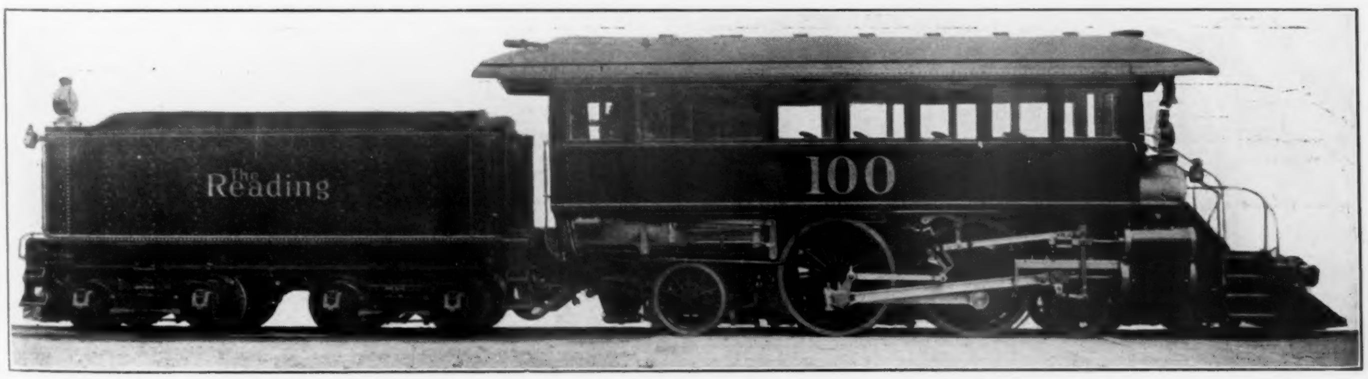
These locomotives were designed in the office of the mechanical engineer and were built at the Reading shops of this company. The Atlantic type wheel arrangement was selected in order to obtain the very wide and large grate area desired. The boiler shell has been made very small in diameter so that it fits between the wheels and in fact is so located that the center of the boiler barrel is but slightly above the top of the drivers. A small wash room is provided in the cab and the fittings throughout are heavily nickel plated, giving the locomotive a very attractive appearance. No provision is made for operating the locomotive from the observation room, but push buttons are provided for attracting the attention of the engineer, and there is an emergency brake valve in each front corner of the observation room. While the locomotive normally is operated alone, it has sufficient tractive effort to handle one or two private cars on a good schedule.

One of the illustrations shows a cross section of the boiler which indicates the efforts that have been made to keep everything as low as possible. The firebox is of the Wooten type and the crown sheet is on a level with the top of the firedoor. Although the height may be very small, the size of the grate is not and an area of 63 sq. ft. has been provided. The usual combustion chamber is arranged ahead of the firebox and the brick wall is used in the normal position. This leaves space for 14 ft. tubes of which there are 180 1¾ in. in diameter, giving 1,154 sq. ft. of heating surface. The dome is so located as to be included in the engineer's cab and could be made as large as was desired. It is 27½ in. in diameter or considerably more than half as large as the barrel of the boiler and measures 34 in. in total height. This will insure dry steam, although it is located directly above the hottest part of the crown sheet. No superheater has been applied. It will be noted in this connection that the crown sheet is very largely supported by sling stays, there being but seven rows of radial stays at the back. Flexible staybolts have been put in the breakage zone on both side sheets. A steam pressure of 225 lbs. is carried on this boiler.

Underhung spring rigging was necessitated by the relative positions of the frames and boiler shell. This is arranged to be continuous on each side for the drivers and trailing wheels, there being four semi-elliptical springs in each set.

The 18 in. x 24 in. cylinders are separate from the saddle casting and the single bar front rail of the frame is enclosed between the two. 11 in. valve chambers are set 7½ in. outside of the cylinder centers and the outside steam pipe extends from the side of the smoke box, underneath the floor of the observation room to the top of the steam chest in nearly a horizontal line.

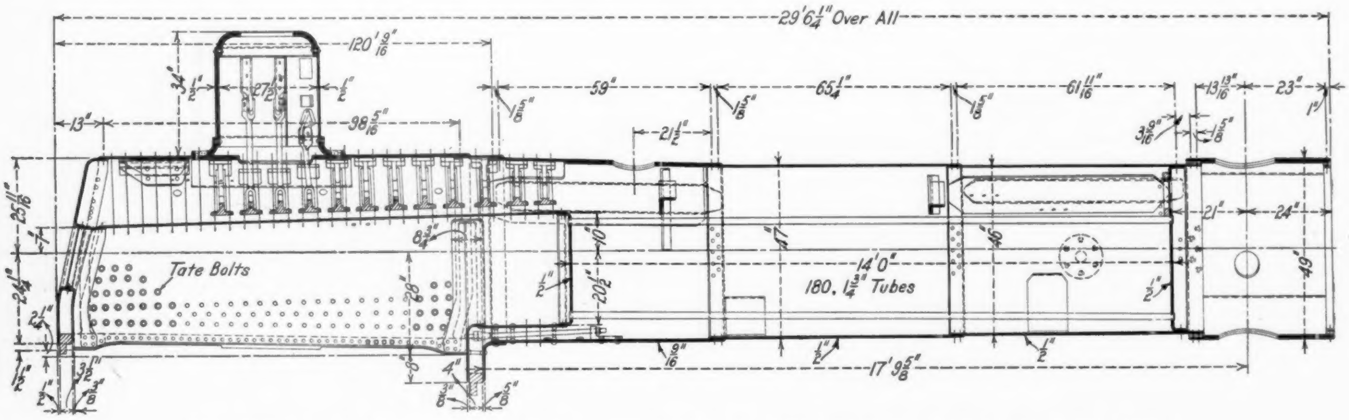
The valve gear is of the Walschaert type with the link supported by a casting extending between the two drivers. Owing to the location of the boiler, it is not possible to carry the lift shaft across the locomotive in a straight line. Furthermore, there is no clearance for an upwardly extending arm on this shaft for connecting with the reverse lever. An arrangement has therefore been made whereby the reach rod from the reverse lever connects to the arm on a shaft bolted on the frame just ahead of the firebox. This shaft extends inward to the center of the locomotive where it has a downwardly extending arm to which a bifurcated reach rod is connected that extends to the downwardly extending arm at the center of the lift shafts for each side of the locomotive. This rod spans the axle of the rear driver. The difficulty of finding sufficient clearance for these



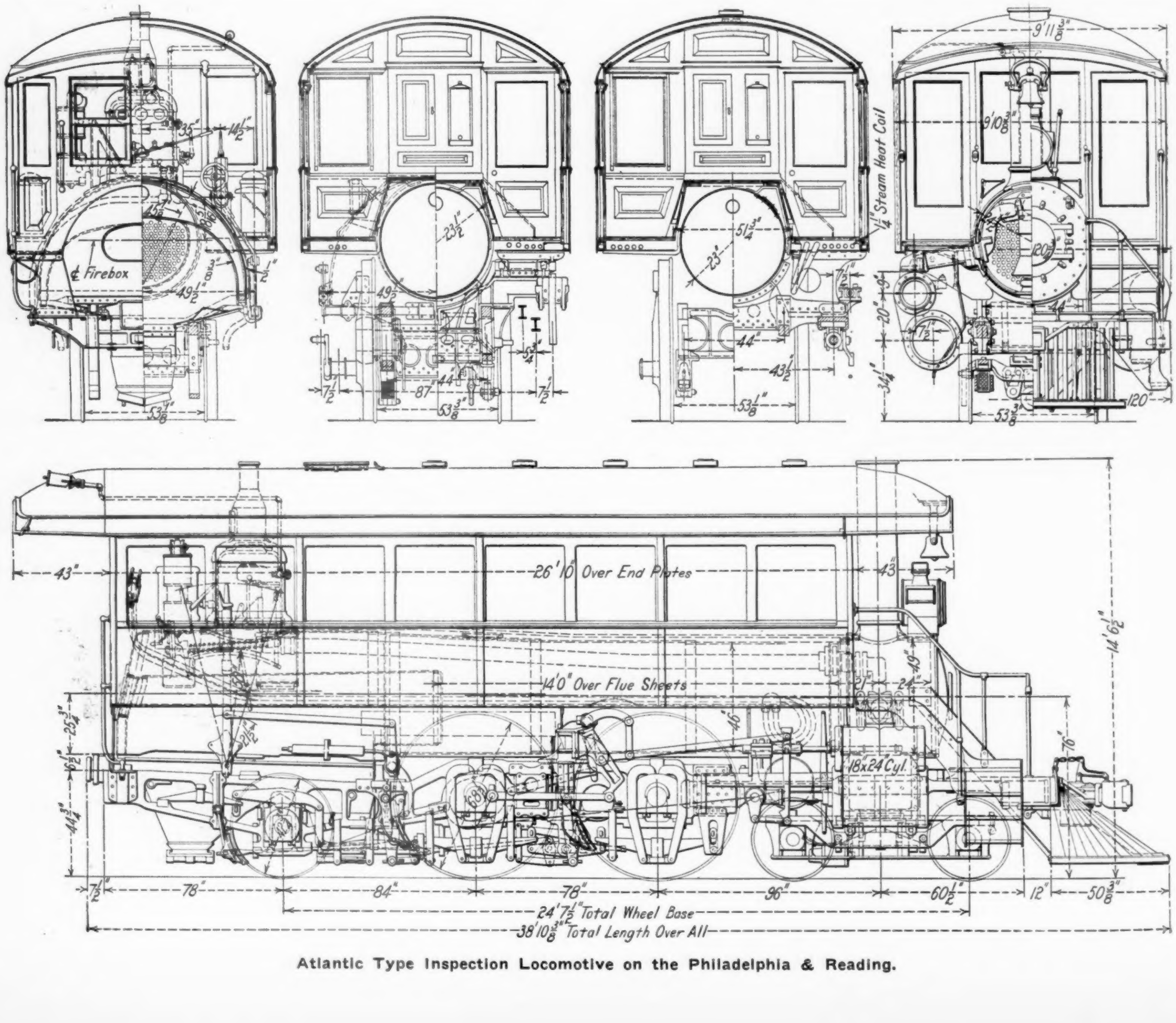
New Inspection Locomotive Designed and Built by the Philadelphia & Reading.

parts and others will be evident from an inspection of the drawing.

One of the most interesting features of the whole design is the combination lever and screw reverse gear that has been provided. The arrangement is such that the engine can be reversed by a lever in the ordinary manner, or if desired it can be adjusted by a screw gear. This combination has been accomplished by having the nut which meshes with the screw cover but the upper half of its circumference. It is set in guides formed by the sides of the reverse lever which span the screw and is connected to the latch by links so that it can be lifted, the screw acting as a quadrant when the lever is being handled by hand. When it is latched, however, the turning of the screw will move the lever to any desired point. Inasmuch as the lever swings from a stationery fulcrum and the screw block in the lever cannot move in a vertical direction, it was necessary to arrange the screw itself to take different angles, depending on the position of the lever. This has been done by carrying the whole screw operating gear on a pinion supported by a casting on the boiler head, as is shown in the illustration. At the front end the screw

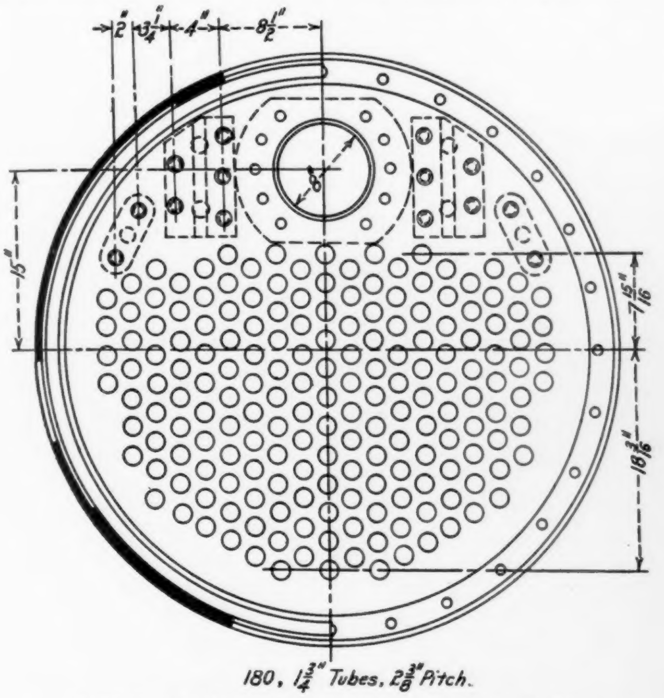


The Boiler of the P. & R. Inspection Locomotive Has a Small Diameter and Large Grate Area.



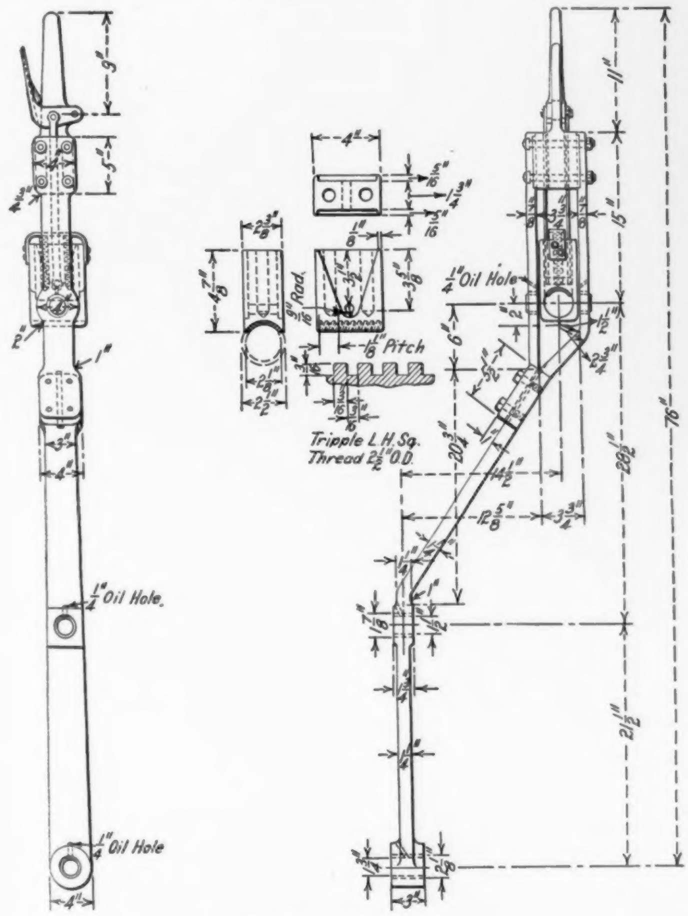
Atlantic Type Inspection Locomotive on the Philadelphia & Reading.

has only a guide to keep it in line. The hand wheel is connected to the screw itself by a train of gears which not only increases



Section of Boiler Showing Arrangement of Tubes.

the leverage of the wheel but also brings it in a more convenient location for handling. One of the illustrations shows the construction of the reverse lever in detail.



Details of the Reverse Lever.

Ample provision for heating the observation room is made by means of steam pipes under the floor. A small turbo generator is provided for supplying current for the electric lights. One of the illustrations shows the interior of the observation car, giving a good idea of the clearness of vision which can be obtained on all sides.

General dimensions, weights and ratios of this locomotive are given in the following table:

General Data.

Gage	4 ft. 8½ in.
Service	Inspection
Fuel	Anthracite
Tractive effort	21,700 lbs.
Weight in working order	161,500 lbs.
Weight on drivers	98,375 lbs.
Weight on leading truck	26,775 lbs.
Weight on trailing truck	36,350 lbs.

View in Cab Showing Combination Screw and Lever Reversing Gear.

Weight of engine and tender in working order	299,500 lbs.
Wheel base, driving	6 ft. 6 in.
Wheel base, total	24 ft. 7½ in.
Wheel base, engine and tender	53 ft. 5½ in.

Ratios.

Weight on drivers ÷ tractive effort	5.13
Total weight ÷ tractive effort	8.41
Tractive effort × diam. drivers ÷ heating surface	1,032.0
Evap. heating surface ÷ grate area	20.22
Firebox heating surface ÷ total evap. heating surface, per cent	10.61
Weight on drivers ÷ total heating surface	77.20
Total weight ÷ total heating surface	126.7
Volume both cylinders, cu. ft	7.06
Total heating surface ÷ vol. cylinders	180.00
Grate area ÷ vol. cylinders	8.92

Cylinders.

Kind	Simple
Diameter and stroke	18 in. x 24 in.

Valves.	
Kind	Piston
Diameter	11 in.
Greatest travel	7 in.
Outside lap	1⅜ in.
Inside clearance	¼ in.
Lead	⅜ in.
Wheels.	
Driving, diameter over tires	68½ in.
Driving journals, main, diameter and length	8½ in. x 12 in.
Engine truck wheels, diameter	33 in.
Engine truck, journals	5½ in. x 10 in.
Trailing truck wheels, diameter	42¾ in.
Trailing truck, journals	7 in. x 12 in.
Boiler.	
Style	Wooten
Working pressure	225 lbs.
Outside diameter of first ring	46 in.
Firebox, length and width	108 in. x 84 in.
Firebox plates, thickness	⅜ in.
Tubes, number and outside diameter	180—1¾ in.
Tubes, length	14 ft.
Heating surface, tubes	1,154 sq. ft.
Heating surface, firebox	120 sq. ft.
Heating surface, total	1,274 sq. ft.
Grate area	63 sq. ft.
Tender.	
Frame	12 in. channel
Wheels, diameter	36 in.
Water capacity	6,000 gals.
Coal capacity	9.75 tons

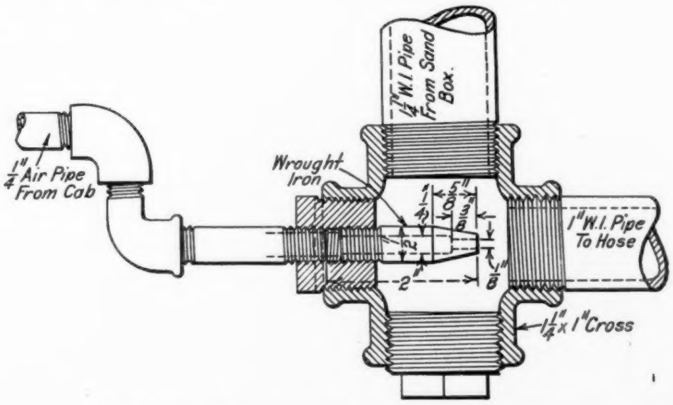
AIR SANDER FOR INTERURBAN CARS

BY F. G. LISTER,
Mechanical Engineer, Oregon Electric Railway, Portland, Ore.

A. C. Adams, superintendent motive power of the Oregon Electric and the United Railways, has designed and had in operation for over a year on all of the passenger motor cars of those roads, a simple and very efficient air sand rigging which is shown in the illustrations.

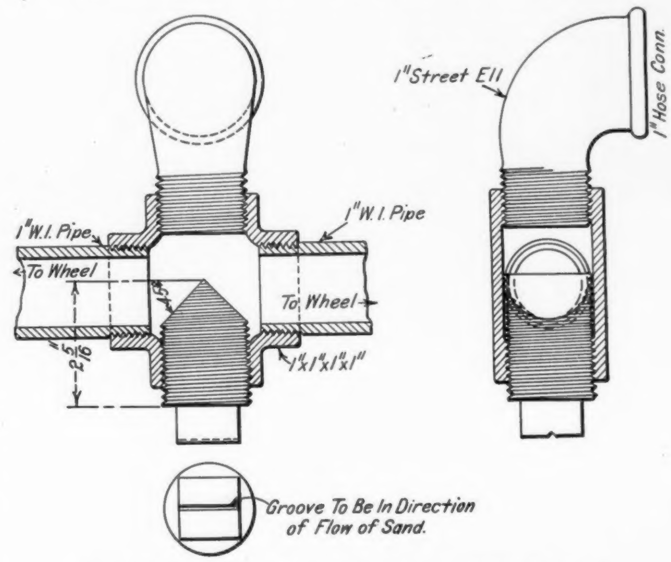
A large sand box, made of No. 14 iron and having a sloping bottom, is provided in the cab or vestibule of the car. The sand drops by gravity from the sand-box through a 1¼ in. iron pipe into a trap made of a 1¼ in. x 1 in. standard pipe cross, which is closed on the bottom with a 1¼ in. pipe plug; the plug can be easily removed in case the trap becomes clogged. Air is admitted to the trap from the whistle pipe through a ¼ in. pipe into a horizontal nozzle which extends about three-fourths of the way through the trap. The admission of air is controlled by a globe valve close to the motorman's brake valve. From the trap the sand is blown through a 1 in. pipe which connects to a 1⅛ in. air hose 36 in. long, providing for the swing of the truck. The bottom end of the hose is fitted with a nipple which connects through a street elbow to a 1 in. x 1 in. pipe cross where the sand is separated by means of a wedge-shaped plug in the bottom of the cross. The separated sand goes to each leading wheel through 1 in. pipes, bent to deliver sand to the rails directly ahead of the wheels and securely fastened to the truck frame.

This sand rigging is made in the company's shops and in



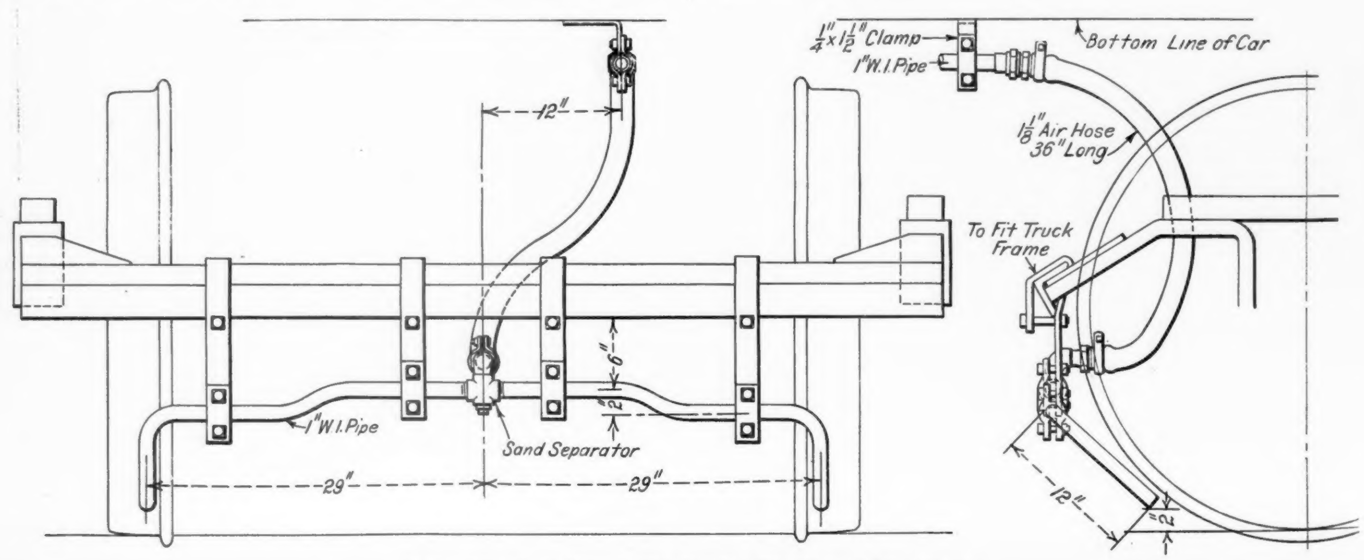
Sand Trap for Air Sander on Interurban Cars.

the entire time that it has been in operation there has not been a single case where sand did not flow freely to the rails. An over-supply of sand cannot feed into the trap, nor has any trouble



Sand Separator for Air Sander on Interurban Cars.

been experienced from sand blowing back into the sand box. Sharp, clean sand is used, and is thoroughly dried in a sand dryer located at the Portland shops.



Arrangement of Pneumatic Sander Rigging on the Truck.

SHOP PRACTICE

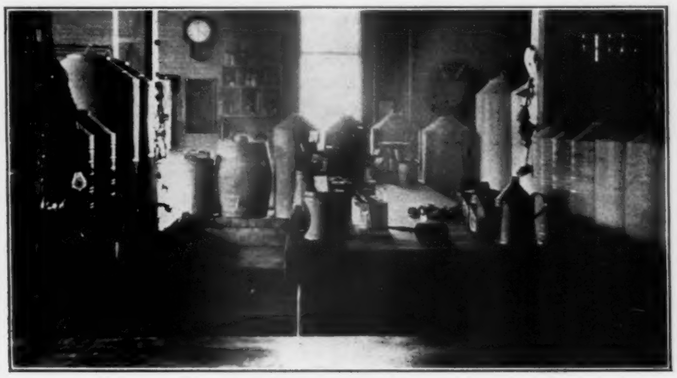
PAINT SHOP AT SEDALIA

The most impressive features of the Missouri, Kansas & Texas car paint shop at Sedalia, Mo., are the generous allotment of space for this work and the neat appearance of the shops. All the departments are carefully laid out under one roof, two adjoining buildings being used for that purpose. The main paint shop is laid with a concrete floor, and is especially well lighted, having a capacity of 35 to 45 cars a month. A doorway in one end of this building connects to the second building, which is two stories high. The lacquer room is located in one corner and is shown in one of the illustrations. The floor of this room is covered with a grating for the men to stand on. All the brass fixtures are cleaned here. The tank in the lower right corner is filled with lye for removing the grease and old lacquer. The next tank, of which only one corner shows, is filled with hot water for thoroughly rinsing the material as it is taken out of the lye bath. The third tank is filled with an acid bath made up of equal parts of soft water, sulphuric acid and nitric acid, to which is added 5 per cent. of a saturated solution of sulphate of copper and 5 per cent. hydrochloric acid. The material taken from this tank is immediately washed in a tank of flowing cold water. It is then dipped in flowing hot water to which has been added a little sal soda to neutralize any acid that may remain on the material. After thoroughly drying the material with a cloth it is dipped in a first class lacquer.

Lacquer Room with Tanks for Cleaning.

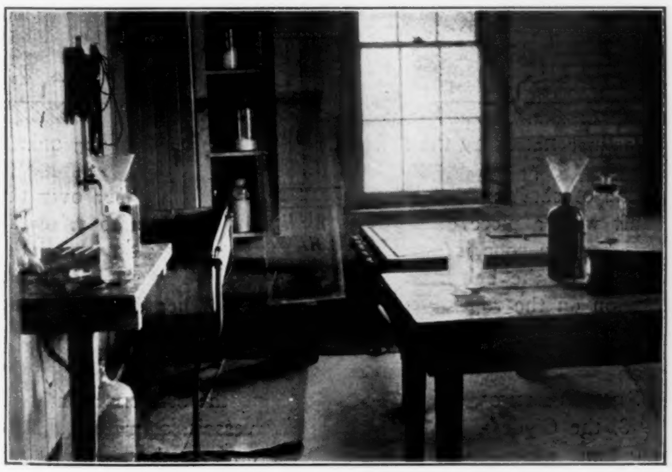
Another interesting feature is the storeroom, as is shown in the illustration. The different tanks are conveniently arranged about a concrete mixing table 4½ in. thick, 3 ft. 4 in. wide and 16 ft. long, supported on eight legs of 1½ in. pipe. The picture was taken directly over the counter.

The electroplating room is also located on this floor. This room is very well arranged and is equipped for copper, nickel, silver and brass plating. The tanks are lined with ¾ in. glass, concrete being placed between the wood and the glass. A motor generator set operating at 220 volts and delivering at 6 or 8 volts with 100 amperes is used for the electroplating.

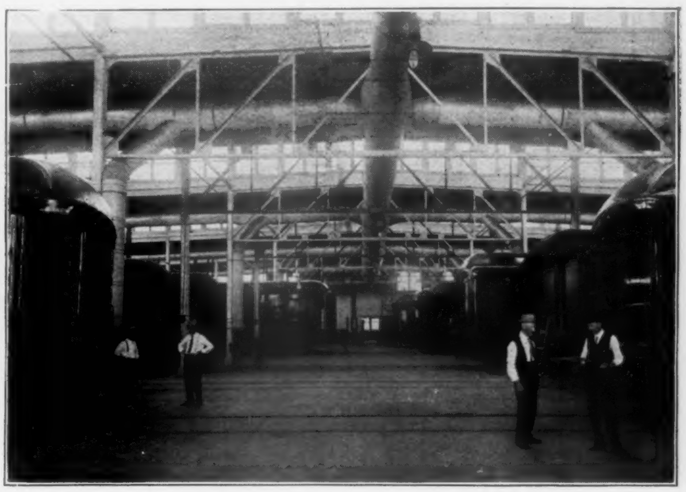


Store Room in the Paint Shop.

The second story of this building is devoted to the glass work, all the designs in frosted glass used on the M. K. & T. cars being made at Sedalia. The silvering room is shown in the photograph. The further table is made of concrete, being pitched toward the center and grooved as shown, so that it may be readily drained. Steam pipes extend through the body of the table, which is 4 in. thick, to heat it to the necessary temperature for silvering. It is supported by iron pipe legs screwed into flanges



Silvering Room and Chemical Testing.



General View of the Main Shop.

on the floor to allow for adjustment when the table gets out of level. This room is also used for chemical testing. There are two other rooms on this floor, one for etching glass and the other a dark room for printing the designs on the glass. The acid or etching room is lined inside with painted cloth to prevent the fumes of the hydrofluoric acid used in the etching process permeating the walls. The acid tanks are lined with lead.

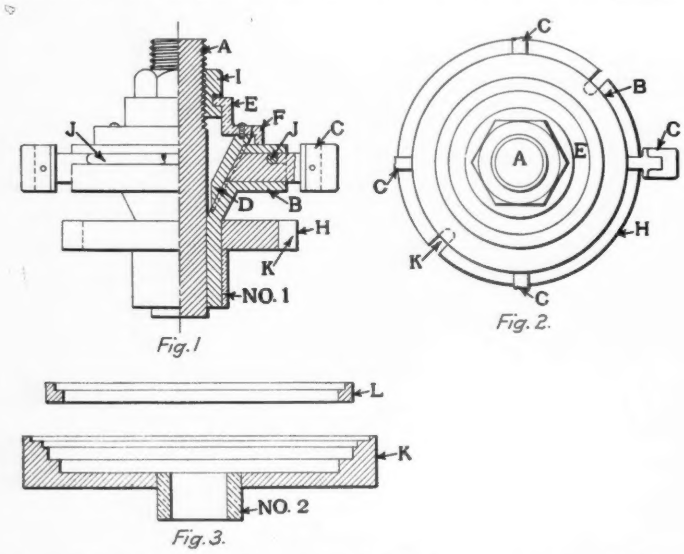
Another interesting and profitable adjunct to the paint shop is the roof board dipping plant. The boards are put in one end of a paint trough through rollers, which force them along through 12 ft. of paint to the other end, where they are drained. This plant will dip 1,200 ordinary freight car roof boards an hour and will use about 2¾ gals. of paint to about 300 boards. The rollers are operated by a 2 h. p. motor.

TURNING ECCENTRIC STRAP LINERS IN A BORING MILL

BY V. T. KROPIDLOWSKI.

The new design of locomotive eccentric strap, which utilizes a brass liner for the wearing surface of the eccentric, has made it a serious problem to finish the liners speedily and accurately. To overcome the difficulty a chuck and centralizing box, which are shown in the illustrations, have been developed.

Fig. 1 is a half side view and half sectional view and Fig. 2 is a top view of the chuck. A pattern is necessary, unless a suitable casting can be found for the body *B;* the other parts are easily made from material available around the shop. First, the stem *A,* of wrought iron, is turned 3 in. in diameter and threaded; the body *B* is then bored out and the stem *A* pressed



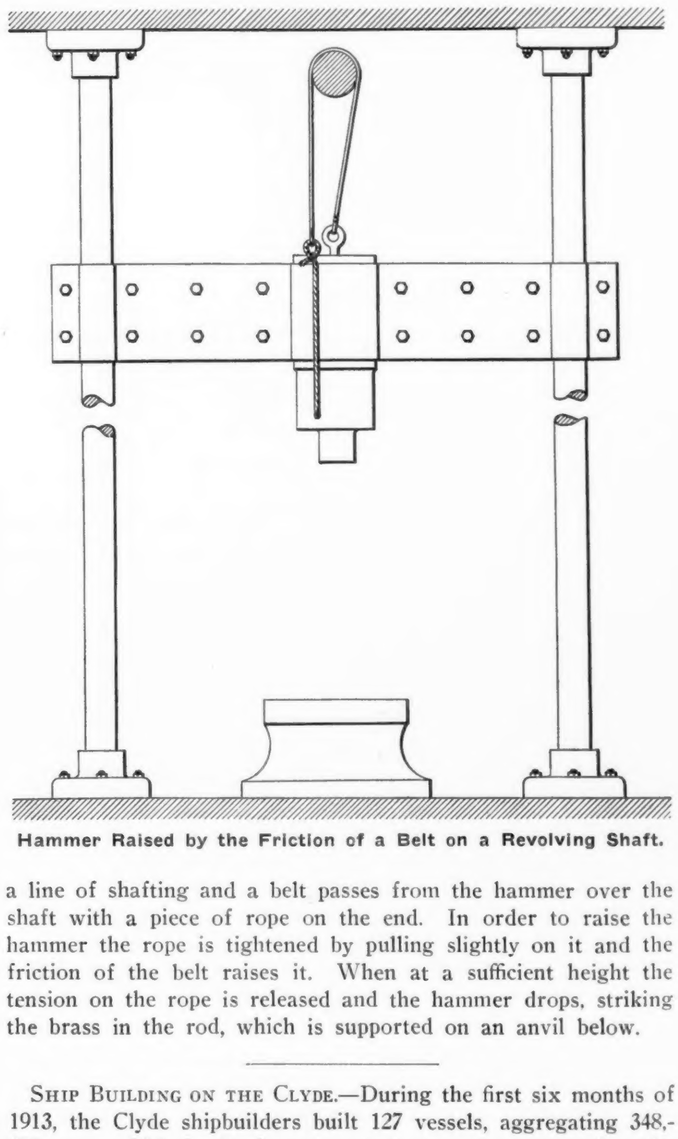
Chuck and Centralizing Box for Turning Eccentric Strap Liners.

into it. The body is then bored to a suitable taper, so that a short range of movement of the taper sleeve *D* adjusts the jaws *C* for the various sizes of liners. The brass ring *E* is fastened with tap screws to the taper sleeve *D,* and its upper lip fits loosely in a groove cut around the nut *I.* By turning the nut *I* the sleeve *D* is raised or lowered by means of the connection of the sleeve to the nut through the brass ring *E.* The spring *J* pulls in the jaws *C* when the sleeve *D* is raised. The extension, No. 1, is made to fit the center hole of the boring mill table, and the chuck is fastened to it by bolts inserted in the slots *K,* in the wrought iron ring *H,* which is pressed onto the body *B.*

Fig. 3 is a sectional view of the centralizing box. Steps are turned on the inner side to receive the different sizes of liners after they are turned on the outside on the chuck. The liners are turned on the outside to fit the different sizes of straps, which are not subject to wear and, therefore, are fixed for all time, and for this reason the steps inside of the centralizing box *K* can be turned to the standard diameters of the liners. The ring *L* is to accommodate a size for which another step in the main body *K* could not be cut. By the use of these tools it has been possible to finish, complete, one liner per hour at a cost for labor of 41 cents.

HAMMER FOR REMOVING SIDE ROD BUSHINGS

At the Norfolk & Western roundhouse at West Roanoke, Va., a simple arrangement is used for driving in and removing side rod brasses. This is shown in the illustration and consists of a pair of iron guides running between the floor and the ceiling. A crosshead, consisting of two iron plates, bolted together, operates on these guides and holds a discarded crank pin, which acts as a hammer. This hammer is directly below



Hammer Raised by the Friction of a Belt on a Revolving Shaft.

a line of shafting and a belt passes from the hammer over the shaft with a piece of rope on the end. In order to raise the hammer the rope is tightened by pulling slightly on it and the friction of the belt raises it. When at a sufficient height the tension on the rope is released and the hammer drops, striking the brass in the rod, which is supported on an anvil below.

Ship Building on the Clyde.—During the first six months of 1913, the Clyde shipbuilders built 127 vessels, aggregating 348,-470 tons, which is the largest output on record, exceeding the next largest output, that of the first six months of 1906, by over 12,000 tons.

Saratoga and Schenectady Railroad.—The receipts on this road during the last week were between six and seven hundred dollars. This, considering the very small number of strangers who have visited the Springs, is very handsome and indicates with much certainty the future prosperity of the road.—*From the American Railroad Journal, September* 8, 1832.

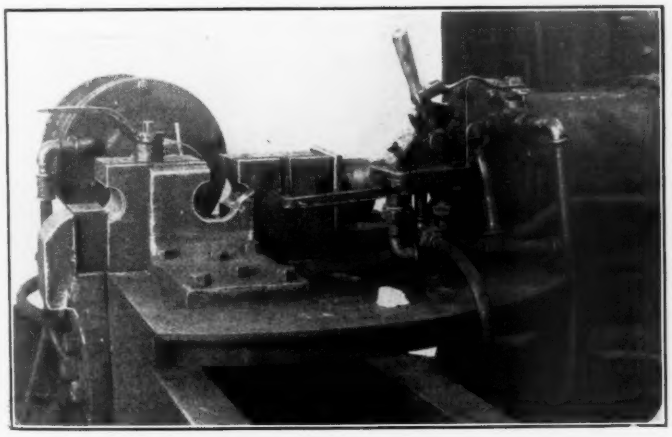
MASTER BLACKSMITHS' ASSOCIATION

Richmond Convention Included Papers on Flue Welding, Spring Making and Electric Welding.

The twenty-first annual convention of the International Railroad Master Blacksmiths' Association was held at the Jefferson hotel, Richmond, Va., August 19-22. President McSweeney called the meeting to order at 10:20 a. m., August 19, after which George W. Kelly led in prayer. W. W. McLellan in a brief speech introduced Governor Mann of Virginia, who addressed the association, welcoming them to the state. Governor Mann was followed by Mayor Ainslie of Richmond, who gave the members the freedom of the city. Addresses of welcome were also made by the president of the Chamber of Commerce of Richmond, by W. D. Duke, assistant to president, Richmond, Fredericksburg & Potomac, and by the Rev. J. T. O'Farrell. On Wednesday a short address was made by W. H. Owens, master mechanic, Southern Railway, Manchester, Va.

FLUE WELDING.

E. J. Haskins (L. S. & M. S., Elkhart, Ind.):—Flue welding and swedging at Elkhart is handled in the blacksmith shop. We have two flue rattlers, one of which is 23 ft. long and one 18 ft. long. These rattlers run about 15 revolutions a minute with a load of about 200 2-in. flues. The 2-in., 2¼-in. and 3-in. flues are cleaned in these rattlers from two to four hours, depending on the amount of scale. The flues, after leaving the rattler, are cut off at the firebox end with a cutter operated by compressed air and having two rollers below with a rotary beveled cutter above. They are then placed on an incline and rolled to a rack near the furnace, where they are heated, the ends belled out on a horn and the safe ends applied; they are then piled on a rack convenient to the welding furnace; one man swedges and welds flues of the three sizes.



Flue Swedge Used on the Oregon Short Line.

After welding, the flues are skidded to racks outside the building, on account of the limited room in the shop. The flues are brought from the rack outside to the hot saw oil furnace, where they are heated and sawed to the proper length on the hot saw. The operator of this saw takes his own measurements from the boiler to determine the length of the flues. They are then placed upright in a pit for the annealing of the ends. Any defects may be readily seen, as the flues are cut while heated.

Five men in the flue department handle from 6,000 to 8,000 flues per month. We use the Ferguson oil furnace and the Draper pneumatic welder and swedger. All the flues are tested on a hydraulic testing machine with 300 lbs. per sq. in. pressure. As some of our flues have four or five welds, we consider it a paying proposition to test them, as we find a number of defects with this method, most of them being in the old welds.

Scarf ends are made from new stock. In cutting them off we leave a scarf on the safe end of about ¼ in.; we heat the end of the flue and bell it on a horn. A safe end is then inserted in the usual manner and set down ready for welding. With this method we obtain a maximum amount of stock around the part of the flue to be welded, which holds the welding heat until after the two parts are welded together. We are able to weld successfully steel on steel, or steel on iron. When bringing a flue up to a welding heat great care must be exercised to heat it uniformly, not too rapidly, and to be sure and not overheat the steel safe end. Unless the operator is very careful he will endeavor to bring the iron flue up to the proper temperature for welding, which will overheat the steel flue, making it brittle and resulting in flues breaking in service, the fracture usually taking place just forward of the weld and through the steel portion.

In the erecting shop the pits are so short that large superheater flues cannot be removed from the modern boilers without opening the erecting shop doors. To prevent cooling the shops in winter and to provide a special platform for applying superheater elements and the large tubes, we have designed special cars that fit in the door openings. They serve the purpose of a door and also a very convenient platform for the workmen in removing or applying the superheater units and the large tubes. The superheater flues of 5¼ in. and 5⅜ in. diameter are cut off, removed from the boiler and placed in the cars. The firebox ends are cut off square by a machine located in this car, and the flues are then brought to the blacksmith shop to be cleaned and welded. We place about 17 of them in the rattler and mix with them 125 short flues of 2 in. diameter; from three to four hours in the rattler cleans them sufficiently. We use safe ends about 6 in. long with an abrupt scarf on one end. The flues are taken from the rattler to the oil furnace, heated, belled out with full thickness of metal and the safe ends applied. The flue is then put back in the furnace, brought up to a welding heat and welded on a 200-pound Bradley belt driven hammer, for which we have constructed a special mandrel and die. We use three men for this operation, a flue welder and two helpers. We do not test any superheater flues welded in this way under the Bradley hammer. Out of the 25 sets of flues so welded we have lost only two flues on account of leaks in the welds. We apply safe ends on large flues with a lap of ⅝ in. before welding. This provides ample stock, and after it is closed and worked under the heavy Bradley hammer it makes a perfect weld. We also swedge superheater flues of 5¼ in. and 5⅜ in. diameter in this same manner, averaging about 11 large flues per hour, welding and swedging.

Fred B. Nielson (Oregon Short Line, Pocatello, Idaho):—It is of more importance to swedge the flues than to weld them. Our superintendent of motive power took the subject up with me to find some way whereby the flues could be swedged without hammering the scale over them, as I am positive even by having the air blowing on the swedge, a certain amount of the scale drops down on the bottom of the swedge and the result is that a certain portion of it is hammered into the flue. In order to overcome this we made a swedging machine operated by compressed air, practically of the same construction as a bolt machine, and have had good success with flues since installing it. The dies are grooved to hold the old flues, which are sometimes a little smaller than the new ones. We have never tried to swedge any superheater flues with the machine, but I am sure it will do the work.

George Massar (C., N. O. & T. P., Ludlow, Ky.):—We repaired 625 superheater flues from January 1, 1913, to June 1, 1913.

We converted our 2½-in. roller machine so the change can be made in 20 minutes to weld 4½-in. or 5½-in. safe ends on superheater flues by changing the mandrel and using the same rolls that are used for welding 2-in. or 2½-in. flues. For swedging them down from 5½ in. to 4½ in. for welding on safe ends, the welding rolls are taken off and taper rolls put on, using the same mandrel that is used for welding. Our flue furnace is so arranged that the change can be made in a very short time from welding superheater flues to the 2-in. size. Instructions have been issued by the superintendent of motive power not to have more than one weld on superheater flues at one time. In order to do this, the flues must be cut off close to the front and back end of the flue sheet to have as little waste as possible. The flues are cleaned in a rattler, taken to the cutting off machine, cut off and scarfed on the inside with a reamer 1¼ in. taper to 3 in., making the scarf ⅝ in. long. The safe ends are chamfered on the outside with the same taper. The cutting of old welds, reaming and chamfering safe ends is done on one machine by changing tools. In welding, the safe ends are put on the mandred cold; the flue is then heated and forced on, this making a neat scarf, as both have the same angle. The flue is then put in the furnace to be welded; when the proper welding heat is produced it is then bumped up, taken out and welded under the roller machine. We use charcoal iron safe ends, No. 10 gage, cut to suitable lengths so as to allow but one weld in each flue. This can be done by first welding on a 5-in. end, second 8 in., third 11 in., fourth 15 in. We have three men on the job, and they average from 10 to 12 flues per hour; they have welded 103 in eight hours. The flues are not tested before being put in the boiler, and we have never had a complaint from the foreman boiler maker.

TOOLS AND FORMERS.

John Carruthers (D. M. & N., Proctor, Minn.):—We have but one forging machine in our shop, and have to use it for both light and heavy work; I think it a good idea, when there is but one machine in a shop, to have a large one, because light work can be done on it, but heavy work cannot be done on a small machine. For instance, we make ⅝-in. grab irons on a 3-in. machine, one end in one heat; these are upset, punched and bent ready to go on the car after two heats.

We started to rebuild a number of cabooses, and needed a lot of pieces bent in various shapes; I had no bulldozer, so had to make one. I obtained a cylinder 19 in. x 24 in,, and some rails and made an air-driven machine which does the work very well. We can bend 6 in. x 1½ in. material, and we also bend drawbar pockets with it.

It is possible to make too many tools. I mean that we can make tools for work that will not pay for the making, because there are not pieces enough to make. It will not pay to make a tool for a machine to make about twelve articles once in six months; it would be cheaper to make them by hand.

Material for dies and punches depends a good deal on what kind of forgings are to be made; we have them made of cast iron, carbon steel, axle steel, tire steel and some cast iron with steel faces. We make most of them of air hardening steel, which we find is the best for punches, as we have them from 3/16 in. to 1⅛ in. round. We punch all of our brake hanger pins and brake rod pins with a round punch, which I find is cheaper than drilling them.

Chas. Popisil (Union Pacific, Omaha, Neb.):—I believe that there are times when it pays both the foreman and his company to make tools or formers for one job only. I had an example of this at Omaha when a man came to the general foreman with a broken manhole plug. He was referred to me and I got a bar of square steel and made a ring the size of the manhole. After I had the proper ring or former made, I took a piece of soft steel large enough to cover the former, heated it and dropped it under the steam hammer, trimmed the surplus off, put the proper radius in and had the holes drilled.

Discussion.—J. E. Carrigan (Rutland Railroad, Rutland, Vt.): —I find we are apt to make a mistake in punching holes. We have got to leave quite a little clearance in the back die for the punch to pass through, as much as with the ordinary punching shears; if we don't we will break every punch we put in. If there isn't enough clearance behind, it will break the end out. I do not use any particular method in hardening my punches. I punch 3/16 in. x 13/16 in. slotted holes in a ¾-in. round, and I have punches that have made thousands of these.

H. E. Gamble (Penna., Altoona, Pa.):—We had to set a number of splice bars with a big pad. It is impossible to do it on the anvil, and it is an impossibility to get up dies for it. I took two pieces of rail the size of the splice, left them apart ¼ in. or ⅜ in. and put them on the press. I built the splices on the rail and I made a perfect job out of No. 100 splice. I do not believe it would be possible to set one of these splices by hand.

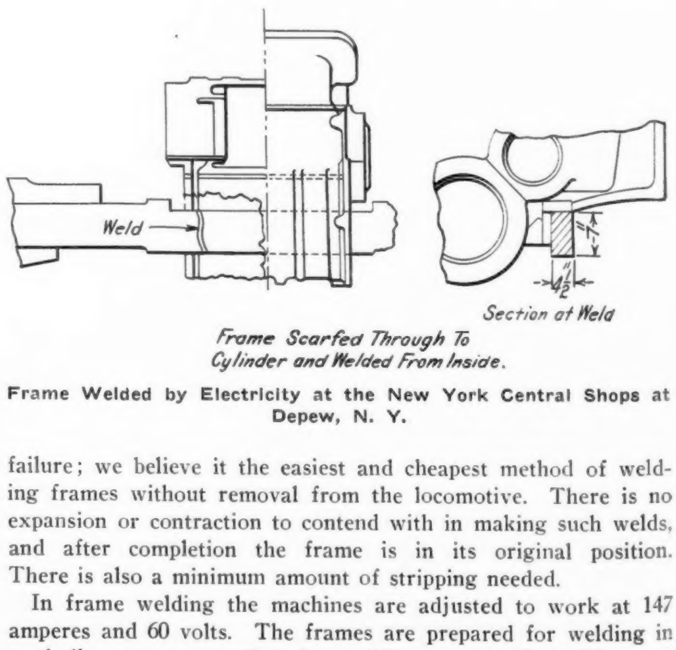
Alex. McDougal (B. & A., Milo Junc., Me.):—When I came to the convention I was instructed by my superintendent of motive power to find out a good scheme for making main and side rod keys without planing them. The only tool I have to work on is a steam hammer.

T. E. Williams (C. & N. W., Chicago, Ill.):—We shear them off in the blacksmith shop. The body of the key is cold rolled steel bought the right size, and it is sheared off the right size.

G. L. Gay (A. C. L., Rocky Mount, N. C.):—We order the steel the size we want it, cut the keys off in the cold saw or shears and put them on the milling machine; a great number are milled at a time, and we find this the cheapest method.

ELECTRIC WELDING.

Joseph Grine (N. Y. C., Depew, N. Y.):—In common with many others, our first experience with electric welding was very disappointing and failures were so many that at one time we came pretty nearly giving up the process entirely. With the discovery of an error in the adjustment of our machines, and its correction, marked improvement in results were obtained at once. We have two electric welding outfits, which have been operated day and night since May, 1912. At one of our shops 102 broken locomotive frames located in all varieties of places and on all sizes of power have been welded, and so far without a single



Frame Welded by Electricity at the New York Central Shops at Depew, N. Y.

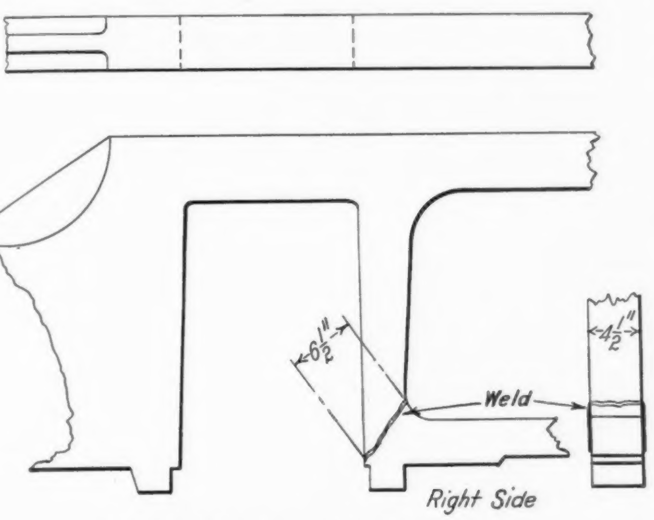
failure; we believe it the easiest and cheapest method of welding frames without removal from the locomotive. There is no expansion or contraction to contend with in making such welds, and after completion the frame is in its original position. There is also a minimum amount of stripping needed.

In frame welding the machines are adjusted to work at 147 amperes and 60 volts. The frames are prepared for welding in a similar manner to that for welding over a fire. They are "V'd" out by means of the oxy-acetylene machine, the oxidized surface left by the burner being then chipped off by an air hammer and chisel so that a clean surface is presented for the electric welder.

The following is the total cost of welding frames of three different dimensions:

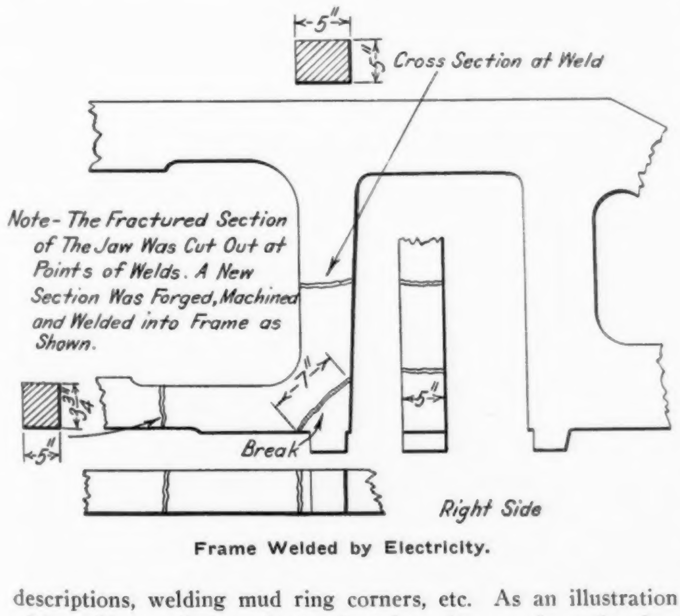
Frame 5 in. x 5½ in.	
Labor	$5.63
Material	3.38
Total	$9.01
Frame 4 in. x 4½ in.	
Labor	$4.01
Material	2.51
Total	$6.52
Frame 4 in. x 2½ in.	
Labor	$3.03
Material	1.95
Total	$4.98

This includes the oxygen used to prepare the frame, wire necessary for welding, as well as the cost of the current used.



Broken Pedestal Jaw Welded by Electricity.

It is very rarely that we have to take down a frame for welding purposes. The process is also being put to many other uses besides frame welding, such as welding firebox cracks and patches, welding flues in the sheets, filling in wasted spots about boilers or fireboxes, filling in worn motion work, filling in frames that have been chafed by spring hangers, plugging holes of all



Frame Welded by Electricity.

descriptions, welding mud ring corners, etc. As an illustration of its utility on firebox sheets, there have been made at the shop referred to 201 firebox welds with only seven failures, or less than four per cent., and those that did fail had an average life of 58 days before so doing.

Another item of saving effected by the process during the past winter is the filling up of flat spots on 46 locomotive driving wheel tires, these spots running in length from 2½ in. to 4½ in. It would, of course, have been necessary to turn these tires had it not been for the electric welder.

DROP FORGING.

F. P. Diessler (Bessemer & Lake Erie, Greenville, Pa.) :—We make a number of drop forgings by making two blocks of steel, top and bottom, with pins at the sides to act as guides. We make a reasonably smooth pattern of what we want, forge two blocks of steel and sink the pattern two-thirds of the depth in each one. We then take these blocks to the machine shop and face them so as to make the impression one-half the depth in each block, and also plane or mill 1/16 in. deep around the edges, and 1¼ in. from the impression for splash. After the dies come from the machine shop we harden the faces and block out or bend the stock to suit the work; we then take a good heat, open the blocks, insert the stock and strike one good blow under the steam hammer. The top block is then lifted and the piece taken out. We try to do this work with one blow, as the tools will last longer, because otherwise the fin chills quickly and dents the edges of the tools. We make trimmers to trim off the fin; this is done cold by making blocks of steel the shape of the work, with clearance from top to bottom, so as to clear when driven through under the hammer. By this method drop forging dies can be made very cheaply and they will do a lot of work that will answer the purpose, and do it quickly. I believe that all shops should have at least one drop hammer, as that is the only way to do this work properly.

H. E. Gamble (Penna., Altoona, Pa.) :—We have a 12,000-lb. steam drop hammer from which we have produced some fine forgings, weighing from 100 to 300 lbs. The dies made for this hammer must be large and well heat-treated to withstand the blows. The larger the hammer, the more roughing out is required from the forge shop. The trimming press used for this hammer is operated by hydraulic power and has a capacity of 200 tons.

G. F. Hinkens (Westinghouse Air Brake Co.) :—The secret of drop forging is in making the dies, and the secret of the die is in making the preparatory part so as to get the stock in the right place before placing it in the finishing die. There is a great deal of skill required by the die maker. I do not think that the ordinary machinist, until he has the experience, can make a die for a drop forging from a blue print or from a model unless he is instructed by somebody who knows how the die ought to be made.

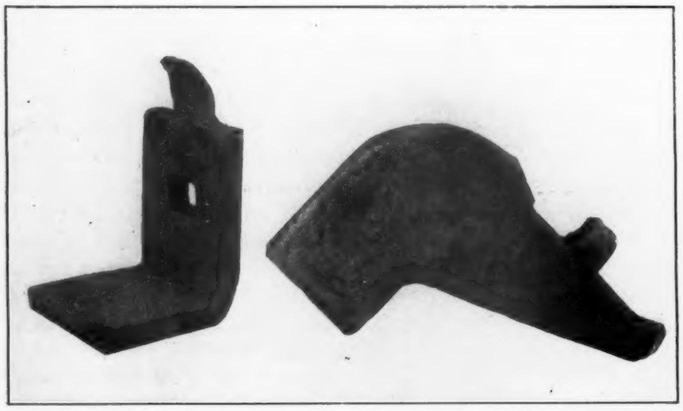
The next important thing is the hardening of the die. Drop forging dies are very expensive, and the cost of the work depends on the number of pieces that can be made by the die, which will range probably from 1,600 up to 40,000, depending on the shape of the forging. We harden all our dies by a special method; they are all tried for hardness.

MANUFACTURING TRUCK TRANSOMS FOR PASSENGER COACHES

George Fraser (A. T. & S. F., Topeka, Kan.) :—The manufacture of wrought iron transoms for passenger coach trucks is a very difficult operation, in the absence of a suitable forging machine capable of forming the transom ends from solid material. A forging machine suitable for such heavy duty requires so large an investment that it is inadvisable to have such equipment where transoms are made in small quantities. Forging a transom of this design in the usual manner by means of the steam hammer and anvil makes the production cost prohibitive and renders it necessary for these parts to be purchased from the builders of coach trucks.

The problem has been very satisfactorily solved at the Topeka shops of the Atchison, Topeka & Santa Fe, by means of dies for use under the ordinary steam hammer. The details of the opera-

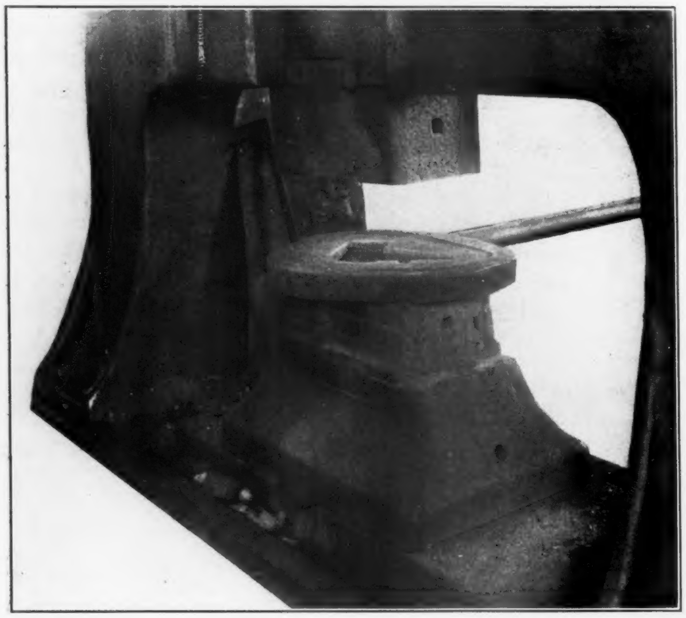
tions are shown in the accompanying illustrations. The two parts of the transom end are punched out separately under the steam hammer. The foot is a piece of bar iron bent at right angles with a square hole and lip to assist in the welding operations. The web is punched from plates of the required thickness with



Two Parts of a Coach Truck Transom After Being Formed with Dies Under a Steam Hammer.

the assistance of the die in position under the steam hammer. The two parts are assembled by inserting the lug on the web through the square hole in the foot and riveting it over slightly to hold the parts firmly together. The parts thus assembled are placed in the furnace and heated sufficiently to be welded together with one operation under the steam hammer.

The die parts are held in position by keys through the cross-bolts, which facilitates the assembling and dismantling for weld-



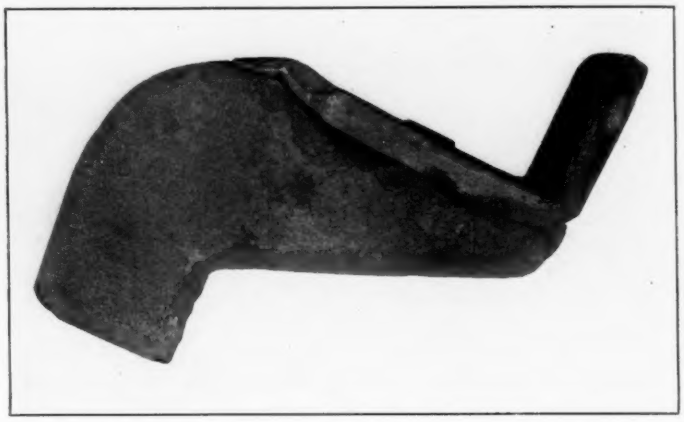
Die in Position for Punching Out the Main Part of the Transom End.

ing purposes. When the parts assembled are sufficiently heated in the furnace, they are placed in position in the die and the welding is completed by several strokes of the plunger. After the transom end leaves the die, the forming has been so well accomplished as to render unnecessary any further dressing or trimming. After the ends have been formed they are welded to the crossarm in the regular manner on the transom.

SPRING MAKING AND REPAIRING.

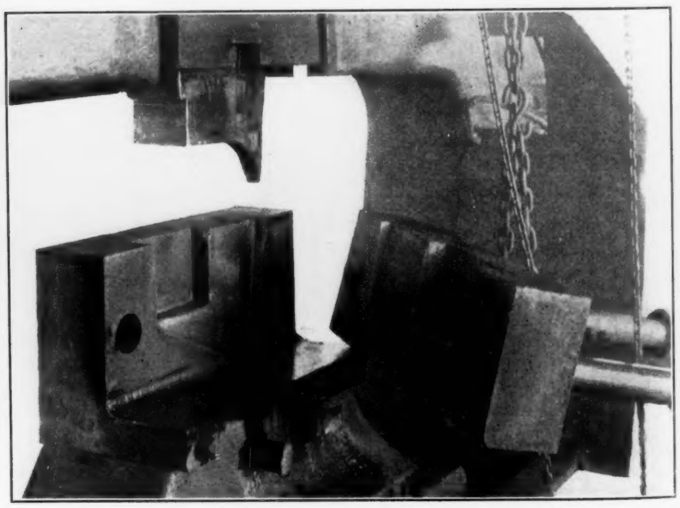
G. M. Stewart (Penna., Altoona, Pa.) :—The spring business has taken the same forward movement that all other industries have, leaving the old hand practice behind and resorting to machinery, the demand for springs now being so great and the need of uniform and dependable work so obvious. There is no question but what spring making has reached the highest point of efficiency possible with the aid of the human eye, but with the use of the pyrometer and machinery, it is possible to turn out more work and have it much more accurate than by hand practice.

One of the machine manufacturing companies is now making a machine for manufacturing springs, to be used by one of the large spring makers at Pittsburgh. There has been installed in one of the Pennsylvania shops a machine for making springs which has proven a success, not one failure having been found in the making and adjusting of 2,000 plates recently turned out.



Parts of Coach Truck Transom End Assembled for Welding.

This machine shapes the plates properly, the pyrometer being used to get the correct temper, and all the plates being exact duplicates. It also shows a saving of not less than 30 per cent. in the cost of production. I may be somewhat premature in saying that elliptical springs will sooner or later be made by machinery, and without the use of a hammer, but in a number of shops this method is now in every-day operation and has resulted in a decided saving and a better spring. An objection may be raised to the machine method on account of the large number of designs of springs generally made or repaired in railroad shops. To induce the designing engineer to change designs will take time. However, if it can be shown that a superior

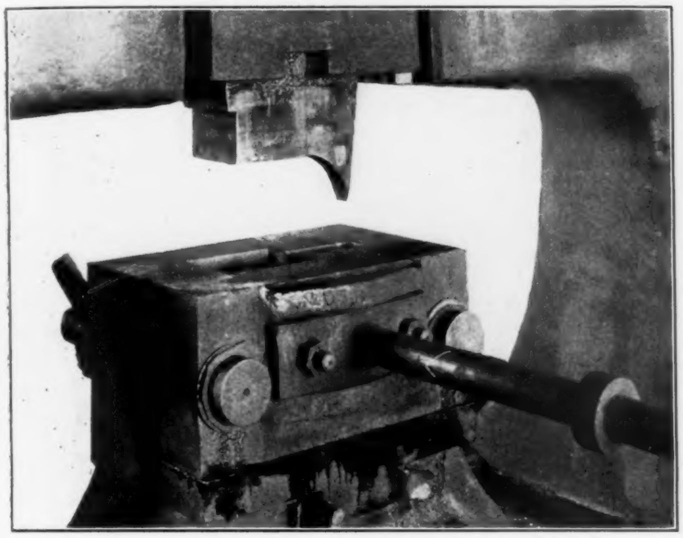


Die and Plunger for Welding Transom Ends.

spring can be made at lower cost, the question of providing the proper machinery will at least receive careful attention, and we may also hope to see a number of springs, differing only slightly, eliminated.

A number of methods of manufacturing elliptical springs by machinery are now employed. All that I am familiar with do

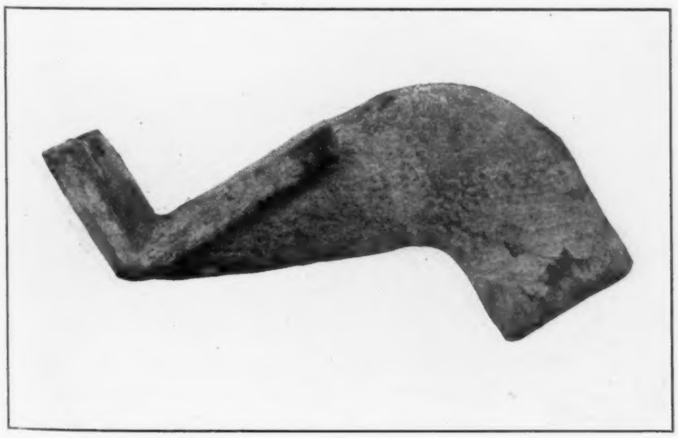
this work in a hydraulic press or a bulldozer. Two methods of bending the leaves have been called to my attention. By one of these a number of fingers set close together like piano keys are employed; these are set to the desired radius by cams or by bolting each finger separately. When these are set the working surface looks like a piano keyboard bent to the shape of a spring. When forming the spring plate it is pressed between two of these keyboards, or one keyboard and a second set of weighted fingers, where each finger has a separate weight. The hot leaf



Dies Assembled for Welding Transom Ends.

is placed on the keyboard and is forced against the weighted fingers, raising each according to the camber. This method looks promising, especially where a large number of designs are required. Another method employed is to use dies, or dies and easily-made liners, for each radius of spring leaf. This requires a number of die liners, but when once made they will last for an indefinite number of leaves. By this method the leaf is pressed while hot between two dies, either in a hydraulic press or bulldozer. Either method will make elliptical spring leaves more uniformly than by hand setting.

For the large elliptical springs, such as are used on locomotives



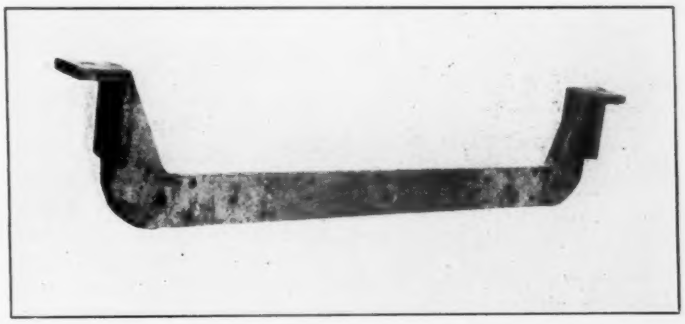
Transom End After the Parts Are Welded.

and cars, the taper put on the leaves is rarely correct, and if properly made it should only extend back from the end about one inch. As a matter of fact the leaves are tapered back two or three inches, and as a result the taper of one leaf extends over the taper of the leaf above, so that the object of tapering is defeated. Some railways have done away with tapering spring leaves, which is a step in the right direction. In some cases the leaf is square at the ends as it leaves the shear when cut from the bar, and in other cases the corners are clipped off, making the end of the leaf look like a spear with the point cut off. Either method makes a good looking spring, and saves the cost of heating the ends for rolling the points. I believe that the tapering machine could be put on the scrap heap, as has been done in one shop that I know of. Omitting the tapering of the leaves makes it much easier to form by dies, as it is difficult to make dies to fit the tapered ends.

There is a method of manufacturing elliptical springs in which a hydraulic press is used. This is a double or two-story press; that is, one press above the other, each controlled by three rams of 25 tons capacity each; by suitable valves 25, 50 or 75 tons pressure may be used, according to the size of the leaf. In the bottom part of the press the end corners of the leaves are clipped off and the nib formed at the center; in the upper half the leaf is formed to the proper radius or camber. Following the leaf through, the process is as follows: The leaves are cut to the proper length, placed in the furnace, and the ends are then cut and the nibs formed in the lower part of the press. Next, the leaf is formed to the proper camber in the upper part of the press, the third and fourth operations being made with the one heat. It is then allowed to cool, and next is heated to 1,500 deg. F. and quenched in oil; it is then heated to 800 deg. F. and allowed to cool in air.

In every-day practice two men can easily cut, nib and form 600 leaves in a ten-hour day. To change from one length of leaf to another takes about 15 minutes; to change from one kind of spring to another takes from 15 to 30 minutes.

Probably no piece of steel is hardened by a much worse method than the locomotive spring. No blacksmith would think of hard-



Coach Truck Transom Complete.

ening a lathe tool in the crude method used in hardening springs, yet with the heavy equipment of today, the spring must stand much abuse. In a number of shops the following is the practice: First, the leaves are formed and allowed to cool off; second, the leaves are heated in a furnace to about 1,500 deg. and quenched in oil; third, they are drawn to about 800 deg. F., taken out and allowed to cool slowly in air. Recording pyrometers showing the temperature, are used on all furnaces; by this method the foreman can keep a record of the temperature. Heat treatment will add from one to two cents to the cost of each leaf, but it is well worth the money, as failures of heat-treated springs are very rare.

As an illustration of what may be done by machine forming and heat treating, by actual practice, 18,000 leaves were handled by this method and not one was broken or failed in a test. Experience indicates that there will be a saving in repairs to heat-treated springs.

Vanadium steel has proven quite an advance; but if it is attempted to harden it by the hit or miss method that has been the practice for spring work, trouble may be looked for. Vanadium steel springs must be properly heat treated and all others should be. Insist on having pyrometers on all furnaces in which springs are heated and see that they are in order.

Discussion.—J. Carruthers (Duluth, Missabe & Northern, Proctor, Minn.):—I have had considerable experience with

vanadium steel for springs. We had some large locomotives with trailer springs that were giving considerable trouble, for the simple reason that we did not know how to use vanadium steel. We take the springs, cut them off and do the preliminary work, then place them in the furnace, which is brought up to 1,650 or 1,700 deg. F. We take the temperature in the furnace with a water pyrometer.

In making trap door springs for coaches we bring the steel up to 1,700 deg. and form it; when it is formed, we put it in oil to cool. It is then put back in the furnace and brought up to 1,450 deg., and it is then taken out again and put into oil; it is next put in a tin bath, which is brought up to 975 or 1,000 deg., so that it shows a dark red.

We treat the carbon steel springs the same way, but we do not get the same results.

PIECE WORK

Geo. P. White (M. K. & T.):—Piece work enables a foreman to estimate the cost of work and length of time that will be necessary to prosecute such work within a very small margin, for the workmen are after the money and know that it depends upon what kind of a day's work they put out, as to the amount of wages they will draw. For instance, we have 500 of a certain class of car to build. Knowing that our material is in stock and we have the drawings to work to, our first line up would be to get out the forgings for the bottom, then the bodies and trucks. A foreman in a piece work shop should be able to tell within a day as to when certain forgings will be received for this work, as he would know the cost that he has to pay for each item, and would also know the amount that each workman would try to make. If it should come about for some reason that the company wanted this work several days ahead of the specified time, it is a very easy matter to push the work somewhat faster in a piece work shop than in a day work shop, for when the workmen can see they are to benefit their pocketbook, they will strain every effort to get just a little more out of each day.

J. H. Dalton (Erie Railroad, Huntington, Ind.):—We work piece work on new and repair work. Wherever there is piece work the output is greater and that is what we are looking for. Some say, under the piece work system they get an inferior grade of work. I don't think so. If a man does a job which will not pass inspection, send it back to him and let him do it over on his own time and he will soon begin to do his work right. Under the piece work system the foreman has got more time to look after his other duties, because if a man gets out of a job he will hunt up the foreman instead of the foreman having to watch him. He will also take better care of his tools and have them ready for the next job.

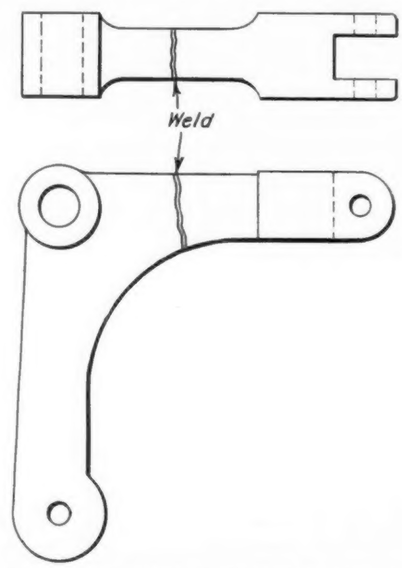
C. E. Lewis (Penna., Baltimore, Md.):—I have had about 29 years' experience with piece work, and think it is the only fair way to have work done. When the piece work system was first started at the Baltimore shops, there was a great deal of prejudice against it. The men seemed to think it was only another way of getting more work out of them, but they soon found that there was an advantage in it for them; and now if you ask a man to work day work he will become dissatisfied at once. I believe that all work should be done piece work. One of the worst things to contend with is that the prices are not set right at the beginning. If you get the price right at first, you will not have much trouble. When you set the price on a job of piece work be fair to the men as well as to the company. We have gang foremen that check the men on and off the jobs. These gang foremen should be men who will not show partiality to any one, as the men will soon get dissatisfied if they are not given fair treatment. I find that piece work is much easier for the foreman, as he does not have to watch over the men to see that they do their work properly. It is just as easy to do repair work by piece work as it is new work. If we repair a chisel we pay so much for the head and so much for the blade; repairing a pair of tongs, so much for each jaw, etc. I find that the man who works piece work has his mind on his work more and find him studying out ways by which he can get out more work. Do not cut prices because a man is making more money, but encourage him to improve the tools and give him credit for improvements that he makes.

Discussion—E. Dixon (W. & L. E., Toledo, Ohio):—Every job in our shop is done by piece work, except coal wheeling and tool dressing. When a job comes in the shop, the inspector takes the time on it and it is entered in a book; when the master car builder gets time he goes over the job and sets a permanent price. The helpers are paid by piece work for building fires; the oiler is paid in the same way for oiling machines. I find if the blacksmiths haven't work they do not stand around; they look for me and if I do not give them work they complain.

OXY-ACETYLENE WELDING AND CUTTING

E. Dixon (W. & L. E., Toledo, Ohio):—In making this report I will submit records for three jobs as follows:

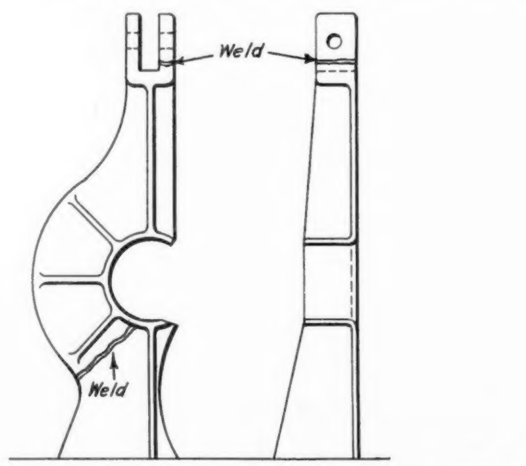
Tail block for 200 ton wheel press; broke on Saturday, March



Arm for Automatic Rivet Maker Welded by the Oxy-Acetylene Process.

8, about 11:30 a. m.; was welded and annealed Saturday afternoon and machine was in working order Monday morning, at a labor cost of $4.20.

Kick-out arm on Ajax automatic rivet maker; broke Feb. 20



Tail Block for 200-Ton Wheel Press Welded by Oxy-Acetylene.

about 10:30 a. m. At 7:30 a. m., February 21, the machine was in running order at a labor cost of $1.05.

Cylinder head on 750 lb. steam hammer; this hammer was

out of commission about 20 hours, and the labor cost was $4.90.

Had we not had the acetylene gas plant we would have had to send each of these pieces to the factory, causing a delay of from 12 to 15 days for each machine.

CASE HARDENING

George Massar (C., N. O. & T. P., Ludlow, Ky.) :—We have double deck furnaces especially designed for our spring work and case hardening. We use cast iron boxes and lids. The pieces to be hardened are packed in one of these boxes of a suitable size. Pack the box carefully with the article to be hardened, so as to allow enough potash when dissolved to cover the work to be hardened. Cover the edges of the lid with fire clay to make the box as nearly airtight as possible. Allow the box to remain in the furnace from eight to ten hours at about 1,600 degrees F. Good results cannot be obtained with a heat that is not uniform. If the heat is too low, satisfactory carbonization cannot take place.

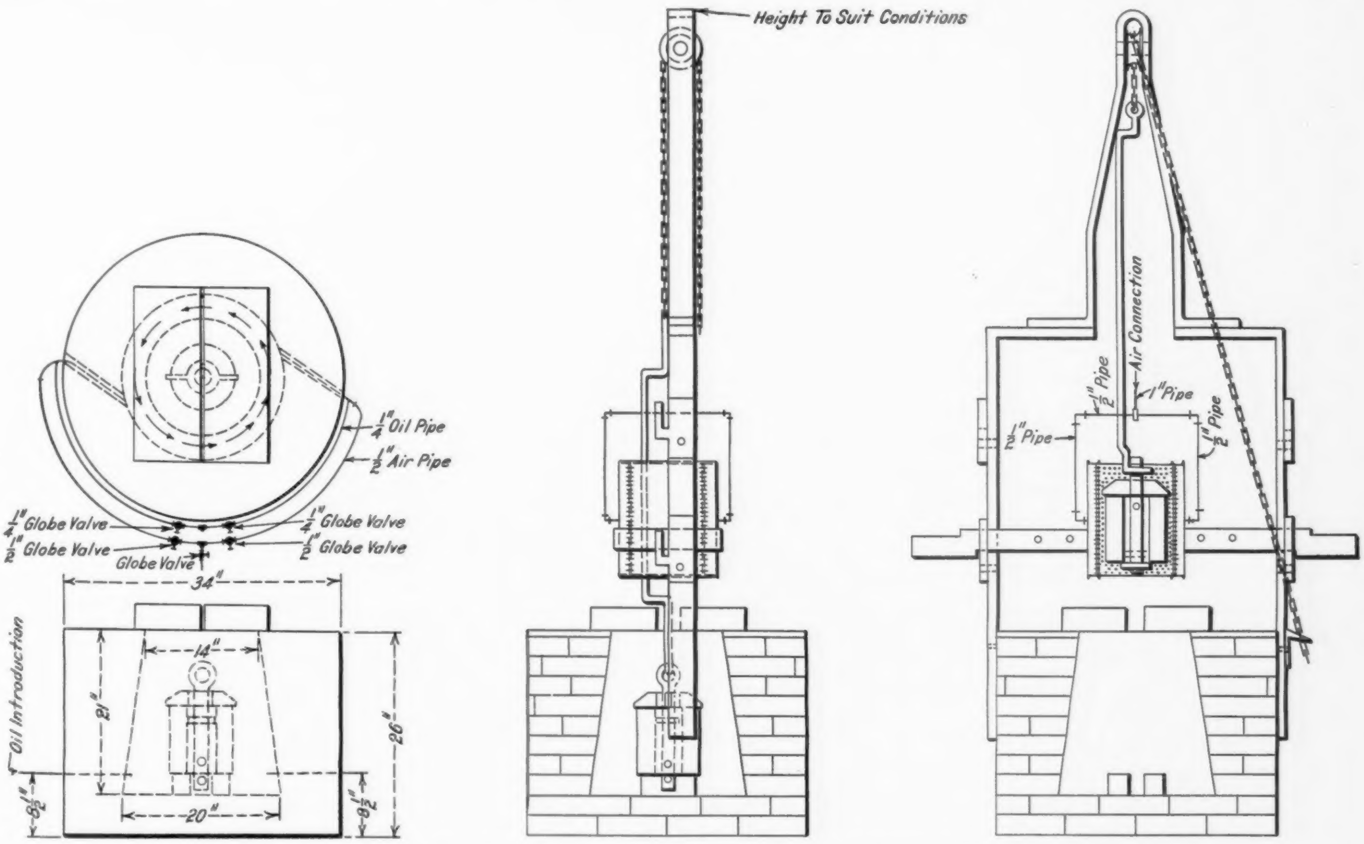
R. E. Cronier (Atlantic Coast Line, Montgomery, Ala.) :—In case hardening I have for the past 12 or 14 years used carbonated bone with prussiate of potash next to the work when I pack the box. I like a wrought box as it is a little lighter to handle, heats through quicker, and will stand more heat than a cast box. I generally burn from 12 to 16 hours, and always take a test piece of ¾ inch or ½ inch round and have 1-16 inch or 3-64 inch on test, which will give me about 1-16 inch or 3-32 inch on an ordinary size link or block which I think very good. I have only a draft furnace for spring work and I do my case hardening in it. I generally pack my own box and see it put in the furnace, and see that red heat is kept on the box if possible. I dip in a clean water bath with wire netting in the bottom so as to keep the water all around the work.

J. P. Kane (Baltimore & Ohio, Newark, Ohio) :—To obtain the proper results in case hardening, a lot of pieces should be packed in a cast iron box of suitable design, say 9 in. deep, 18 in. wide and 30 in. long, with a lid to suit. Cover the bottom of the box with 1 in. of the carbonizing material, then place the work to be hardened 1 in. from the ends and sides of the box, and ½ in. between pieces; cover this with 1 in. of carbonizing material, and place the lid on the box. The length of time required in case hardening is regulated by the depth of the casing desired and the size of the pieces. At the close of the carbonizing period the box should be allowed to cool with the work undisturbed until cold; then remove the work from the box and reheat it slowly to from 1,450 to 1,472 degs. F. and quench in cold water, oil or brine, as the hardness requires.

C. A. Sensenbach (Penna., Sunbury, Pa.) :—The factors governing case hardening are equipment, temperature, time, and the nature of material. I have placed equipment first, as I do not believe it is possible to get good results with a slip-shod equipment. Good results cannot be obtained unless the temperature is even. If the temperature is allowed to go below 1,300 deg. F., the carbonizing stops, and decarbonizing is liable to take place; if the temperature is allowed to go as high as 1,850 deg. F., there is a tendency to crystallize the metal, and it is an accepted fact that a good penetration and good depth cannot be obtained with an uneven temperature. I have found that a temperature from 1,500 to 1,650 deg. F. gives good results, of course depending on the material used, but it must be maintained at that point or the results will not be good, and will show an uneven case after the reheating.

On small pieces I have obtained 1-16 in. case in 5 hours' carbonizing. On large pieces, such as links, crosshead pins, etc., I have found it necessary to run as long as 16 hours, carbonizing time. I think with the proper equipment a regular chart could be tabulated.

The factor of material is a delicate one and the source of considerable argument, and I believe there are as many combinations of materials used as there are railroad shops. The old style of material was raw bone, and I have had some fair results with it, but my principal objection is the tendency to pit and scale the pieces, caused by the excess of moisture and



Furnace and Air Cooling Chamber for Hardening High Speed Steel Cutters; Louisville & Nashville.

sulphur in the bone, and also it seems impossible to get two batches alike. I also strongly object to the use of any cyanide preparation on account of the poisonous fumes. I have obtained excellent results with hydro-carbonated bone black and prefer it to raw bone, as I have found it more uniform, which is very essential. I have also been able to get a good depth of case in a reasonable time.

HEAT TREATMENT OF METALS

H. E. Gamble (Penna., Altoona, Pa.) :—We have a plant for heat treating locomotive parts, and the results obtained are beyond first expectations. I believe that the heat treating of the steel casting must come, especially the main frames of the locomotive, as the annealing of the main frames is not enough. They need some refinement; why not quench them, as we would other parts of the locomotive?

James A. Ridgely :—In heating tool steel of about .9 carbon, it goes through many changes. Take as an example a piece of properly annealed tool steel at atmospheric temperature; in heating, the temperature will rise uniformly until it reaches about 1,300 deg. F. Here the temperature remains stationary until certain internal conditions have been satisfied, when it again rises uniformly to about 1,400 deg., when the second transformation takes place. The temperature again remains stationary until this has been completed, and it again rises uniformly to about 1,550 deg., where the third change takes place. These changes have been designated as the recalescent points, and we will refer to them as Ac-1, Ac-2 and Ac-3.

If suddenly quenched in water at Ac-3, or 1,550 deg., the steel will be very hard and coarse, and the metal will be held in the condition in which it was placed by the applied heat. If allowed to cool slowly the temperature will drop uniformly until slightly below the temperature at which the transformation took place. This point has been designated as Ar-3. When the changes in the structure and grain have been thoroughly completed, the heat again falls uniformly until it reaches a temperature of about 1,350 deg., at which point the second change takes place, which is the opposite to that on the rising temperature, and has been designated as Ar-2. After the change has been completed at this point it again lowers in temperature uniformly to the next point, Ar-1, or about 1,250 deg.; after this change it gradually lowers to atmospheric temperature. These have been called the decalescent points.

During these changes in the metal the iron assumes three different conditions. While the temperature is rising to Ac-2, it is highly magnetic and has been called Alpha iron, or "A," or ordinary soft iron, as we know it in ingot iron or steel. At about Ac-2 it loses its magnetism, and between Ac-2 and Ac-3, it is as non-magnetic as brass and has been called Beta iron or "B," a hard variety as we know it in hardened steel. This change in magnetism is accompanied by a change in electric conductivity and specific heat. At Ac-3 another change in electrical conductivity takes place, and also in the metal's crystalline form. Above Ar-3 it is called Gamma iron, and is very low in tensile strength.

The question of when to quench this steel after it has reached the recalescent point has been asked many times. The writer has found that a variation of 100 deg. can be allowed in the temperature without doing harm to steel ranging from .85 to 1.30 in carbon, covering tool steel for general work, and also finds that steel containing 1.20 carbon can be quenched at as high a temperature as 1,472 deg. without injury to the steel.

CAST STEEL IN THE BLACKSMITH SHOP

George F. Hinkens (West A. B. Company) :—The most important element in steel, so far as the tool user is concerned, is carbon. Cast steel is iron and combined carbon in the hardened state, and iron and graphite carbon in the annealed state. The tool smith should know the carbon points of steel he is working. For example, if he has been in the habit of making milling cutters out of steel containing 125 carbon points he knows just what degree of heat is suitable for the right temper. If he should receive a piece of steel with only 110 carbon points, he would get the milling cutter too soft, yet he could in either case make a satisfactory tool if he knew the carbon points. Purchasing agents should bear this in mind, and give the mechanical department what they call for, for it is both common sense and true economy to leave such matters to their judgment.

A point in this case means one one-hundredth of 1 per cent. The following is a classification of tool steels: One hundred and fifty carbon points, suitable for tools for lathes, planers, boring car wheels, etc.; 135 carbon points suitable for large lathe and planer tools, medium size dies, etc.; 125 carbon points suitable for taps, reamers and drill; 115 carbon points suitable for screw cutting dies, chisels, punches and milling cutters; 105 carbon points suitable for cold chisels, punches, dies, large taps, milling cutters, small shear knives; 95 carbon points suitable for large punches, shear blades, large dies and some blacksmith tools; 85 carbon points for stamping dies, hammers, cold sets, track chisels and smith tools; 75 carbon points for swedges, flatters, cupping tools and blacksmith tools generally. In ordering steel give the temper, or state the purpose for which the steel is to be used. The carbon points given are obtained from average results, but must not be adhered to strictly, as conditions may necessitate a deviation. For example: a lathe tool for turning hard tires, tool steel, or for hard roll turning will require 150 carbon points, whereas a lathe tool for turning bolts or soft material will require from 125 to 135 carbon points. The speed of the machine and the nature of the material to be cut are factors.

It is very discouraging to the steel maker to find that after all his care and expense his product is abused in heating after it leaves the mill. Unequal heating will produce an inequality of the particles, and will cause their displacement in one direction or another when steel is subjected to the forging process. In working a piece of steel with uneven heat the particles are pushed out of their normal position and no amount of annealing can altogether replace them. The particles of steel will arrange themselves only in obedience to natural laws. Forging steel at a black heat will crush the particles or bring about rapid crystallization or enlarged crystals. Steel should be in a plastic state during the process of forging, and the heat should be as even as it is possible to have it; the force of the blow should also penetrate the whole mass so as to prevent the drawing of the exterior surface away from the core or center. When the outside of the steel is worked more than the inside, the effect is telescopic, and the steel can only be rehabilitated by annealing, and then by no means will the temper be uniform.

Overheating of steel changes the particles of pure steel to crystals of oxidized carburet of iron, and by cooling in water little diamond points of combined carbon and steel are fixed, but fixed so loosely in this crystallized frame work that holds them that it breaks down and they crumble out. Overheating underheating, overworking and underworking will change the structure of steel, that is, down to 40 carbon points and below. Every degree of heat in any of its stages registers itself in a piece of steel. The higher steel is in carbon, the more mercurial; in other words, high carbon steel is more sensitive and yields to influence more readily than low carbon steel. The proper heat is learned only from experience. If the toolsmith, in forging a tool, were to reduce a piece of steel from 6 in. to 3 in. in diameter, he would use a higher heat than in reducing a piece of steel from 2 in. to 1⅞ in. in diameter. In the first or larger piece he heats up the coarse grain, but the sufficient amount of hammering in reduction of bulk refines the steel and no harm is done; if the second or smaller piece is heated up to the same high heat as the first piece, he starts with the same coarse grain as in the larger piece, and a reduction of only ⅛ in. in diameter under the hammer is insufficient to hammer-refine the steel; the larger piece will hammer-refine and reduce in heat at the same

time. Not so with the smaller piece; it will receive no hammer-refining and the high heat will leave its structure coarse.

The object of annealing is two-fold; to remove any discrepancies due to forging, and to soften, so it can be worked into any desired shape. The restoration of the particles of steel that have been changed by forging, to their normal state, is brought about by annealing. The annealing due to slow cooling will remove in a great measure all undue strains that were put in the steel by hammer, sledge or steam hammer. Annealing allows the particles of steel to arrange themselves in their right condition, but we must remember that bad strains can only be imperfectly eliminated by annealing, and it should be the inflexible purpose of the toolsmith to guard against working strains into steel while forging. Steel that has been improperly worked, that is, that has had the grain crushed, cannot be rectified by annealing; there is a certain amount of brashness that no annealing can eliminate.

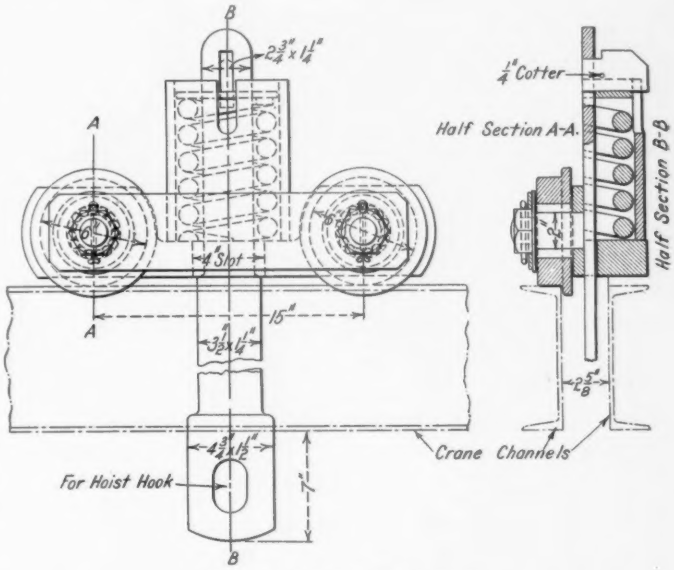
The action of heat is closely related to the hardening process, and the value of the physical and carbon properties are known to be dependent on the degree of heat in the steel before immersion. In speaking of heat for hardening, we are governed by carbon points; the higher the carbon, the lower must be the heat. When a tool is fractured, if it shows a sandy grain, it proves that the steel was overheated; if, on the other hand, the grain is fine and of clear appearance, it indicates a proper heat; if a variation in grain, it indicates uneven heating. Cooling a piece of steel that is unevenly heated causes a complex arrangement of the particles, a separation in one place and a crowding in another, thus producing strains and water cracks. In cooling, keep the water in motion. If the article to be hardened is bulky, the heat radiating from it will repel the water, and envelop the article in a film of steam surrounded by hot water, and as steam and hot water are poor conductors of heat, they will prevent rapid cooling. By keeping the water in motion, the article to be hardened is kept surrounded by cold water, thus causing more rapid cooling and an increase in hardness. The more instantaneous the cooling, the more harmonious the particles. The time required to heat a piece of steel for hardening depends upon the size and shape of the article, and may be anywhere from a few seconds up to several hours. A milling cutter, 8 in. x 10 in., will require from three to four hours.

In order to obtain the right depth of hardness in a tap or reamer, a good way is to take out a worn-out tap or reamer and use it as a trial piece, both as to heat and length of time for keeping in the water. Break a piece off and the effect will be seen on examination. Hardening in oil, or combination of oil and water, has its limitations, however, and we must be governed entirely according to conditions. The object of a soft center in a tap or reamer is to increase the torsional strength.

HAMMER CRANE SHOCK ABSORBER

George W. Kelly (C. R. R. of N. J., Elizabethport, N. J.):—A crane shock absorber is a device which eliminates the continuous jarring and sudden jerks transmitted to a crane. The main saddle is made of forged steel and is provided with holes for wheel pins and acts as a seat for a coil spring and spring cage. The ends of the saddle are 1¼ in. thick, swelling out in the center to 7 in. diameter. The spring cage is 5¾ in. inside diameter, 6¾ in. outside diameter and 9 in. long. A slot 3 in. x 1 in. is provided on the upper end for the clearance of the key in its vertical motion.

The trolley roller is made of forged steel and provided with a flange to prevent lateral motion. The wheel has a 3 in. bore to accommodate 15 15/32 in. diameter steel rollers, 2 in. long, case hardened. This roller bearing is a decided improvement over a plain bearing, especially when exceedingly heavy forgings are to be manipulated. The rollers cannot fall out, being held in by the saddle on the inside and by a steel washer on the outside, which is 5 in. in diameter by ⅛ in. thick. This in turn is secured by a 1½ in. nut on the end of the wheel pin. Owing to the vibrations of the crane proper due to the heavy hammer blows, the various nuts should be provided with lock washers, etc. A piece of flat bar iron 4 in. x ¼ in. thick, having hexagonal holes to fit a 1½ in. nut, at the proper centers of the pins, which are 15 in.



Shock Absorber for Cranes.

in this case, serves this purpose. To prevent these keepers or lock straps from slipping off a 5/16 in. cotter is provided in each nut and pin.

EFFICIENCY

George F. Hinkens (West. A. B. Company):—Efficiency is systematic organization and practically a community of interest. What we are particularly interested in as foremen is shop or industrial efficiency. Industrial efficiency is not applied science. There is always more or less trouble in attaining the proper degree of efficiency. If the most efficient engineer or expert take hold of a demoralized and disorganized concern, let him not think he is going to embark upon something with the belief that all is to be smooth sailing, for if he does he is certain to be disillusioned. We must deal with human nature as we find it, not as we would like it to be, consequently in striving for greater efficiency and better service we must ever bear in mind the human factor. Much has been written on efficiency movements, and much of it has been received with mistrust from the laborer's standpoint. To the workingman the adoption of new methods and labor saving devices means a reduction in the force of employees. This belief is erroneous, and it is the part of efficiency to counteract it. Lack of appreciation on the part of a foreman tends to make an employee careless and discourages him. As a rule, men will work better and more cheerfully if their work is appreciated. A passing compliment on the manner in which good work is done is a stimulus at all times. Give your best men a sense of responsibility. Use good judgment in choosing workmen to do something on their own responsibility and thereby bring their skill and ingenuity into play. If you have such men let them realize that you think they have brains and the freedom to use them.

Excessive hours of labor, usually called overtime, are not conducive to efficiency, because the workers become fatigued, and therefore are not able to do the same quantity or quality of work. Too many hours of work puts a nervous strain on the worker, causing bodily and mental fatigue, and it makes work monotonous and burdensome. Workers should be physically and mentally fresh when commencing work in the morning. Too much overtime will exhaust the vitality of the worker.

Good men in the ranks are an asset and should not be sent home when a slackness in business occurs. Keep your best men

constantly employed, for if you do not they will go where they are appreciated. Send the men home who make it the rule to do as little as possible and still hold their jobs and draw wages. I would rather pay a good man five dollars for loafing when you cannot keep him busy than lose many times five dollars on a man less qualified. Select men who will fill to the fullest the place they are best fitted for. The majority of men have in them only one limited gift and it does not require an efficiency expert to discover that gift. If a man has only one talent and that coupled with sincerity, we have a man who can faithfully serve and give good measure, providing he is placed right. No one outside of a Socialist would give a two dollar job to a ten dollar man. Two dollar men are not to be scouted except when they try to do ten dollar work.

OTHER BUSINESS.

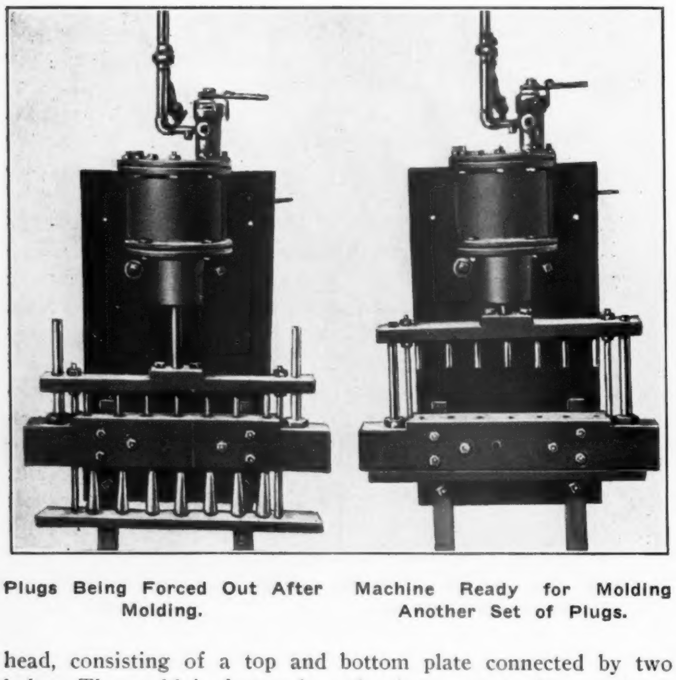
The following officers were elected for the ensuing year. H. E. Gamble, Pennsylvania Railroad, Altoona, Pa., president; T. F. Buckley, Delaware, Lackawanna & Western, Scranton, Pa., first vice-president; and T. E. Williams, Chicago & North Western, Chicago, Ill., second vice-president. The executive committee is composed of J. P. Sullivan, chairman; T. F. Keane, Fred Norris, J. F. Keller and F. F. Hoeffle. The executive committee was instructed to choose from Denver, Milwaukee and Buffalo for the place for next year's convention. The report of the secretary showed that there are 244 active members, 25 associate and 8 honorary.

MOLDING DRIVING BOX PLUGS

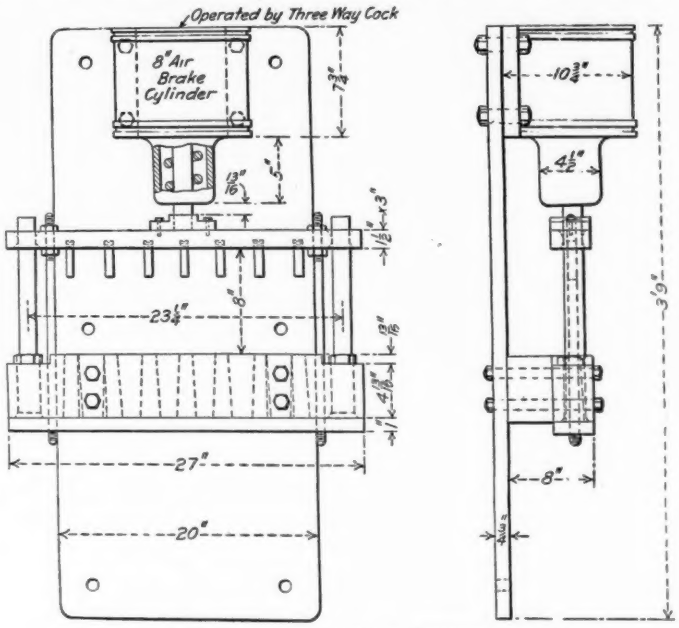
BY WALTER R. HEDEMAN.

The brass plugs used to hold the crown brasses in driving boxes, which are tapered and driven from the inside of the box to prevent their coming out, formerly cost 1½ cents each in a certain shop. With the machine shown in the illustrations they can be made for ½ cent each.

In the construction of the machine, an 8 in. brake cylinder is mounted on a frame and the piston rod is connected to a crosshead, consisting of a top and bottom plate connected by two bolts. The mold is fastened to the frame, and when ready to pour the plugs, the bottom plate of the crosshead is held up against it by a spring applied in the cylinder. After the plugs have solidified, they are ejected by admitting air to the top of the cylinder and lowering the crosshead far enough to push all the plugs out on the bottom plate. A strip of asbestos about ¼ in. thick is used on top of this plate which effectually closes the mold when the crosshead is raised and also prevents the plate from getting too hot. After the plugs are removed from the plate the air is exhausted through a three-way cock applied to the pipe in the top of the cylinder, leaving the spring free to return the crosshead to its original position.



Plugs Being Forced Out After Molding. Machine Ready for Molding Another Set of Plugs.

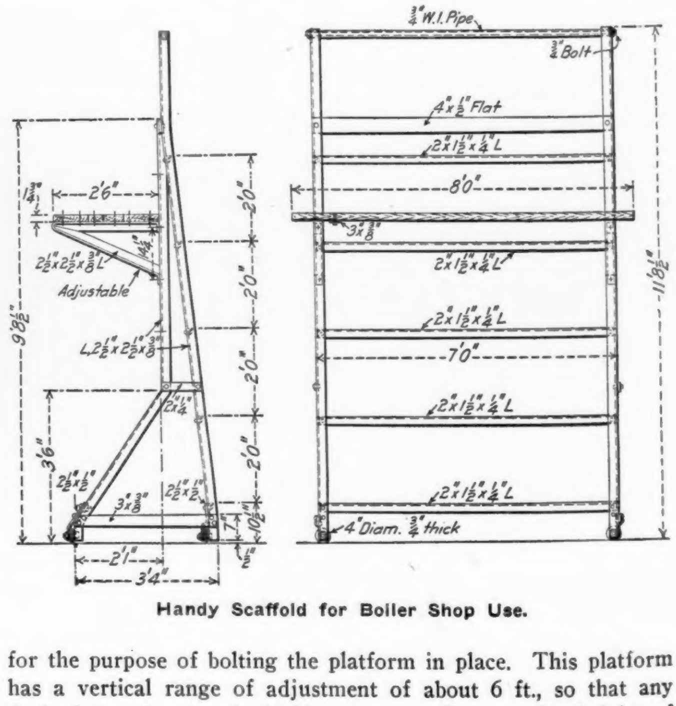


Details of Machine for Molding Driving Box Plugs.

BOILER SHOP SCAFFOLD

BY P. E. COSGROVE,
Foreman Boilermaker, Elgin, Joliet & Eastern, Joliet, Ill.

The illustration shows a handy scaffold for use in a boiler shop. It is easy and cheap to construct, being composed almost entirely of commercial angles, and can be readily moved from place to place about the shop, as it is supported on small wheels or rollers. Holes are provided in the vertical angles in front for the purpose of bolting the platform in place. This platform has a vertical range of adjustment of about 6 ft., so that any desired location is obtainable corresponding to the height of the work.



Handy Scaffold for Boiler Shop Use.

CAR DEPARTMENT

CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION

The fourteenth annual convention of the Chief Interchange Car Inspectors' and Car Foremen's Association was held at Minneapolis, Minn., August 26, 27 and 28, J. L. Stark presiding. Rev. G. T. Lawton offered the opening prayer. The association was welcomed to the city by the mayor, Wallace G. Nye.

PRESIDENT STARK'S ADDRESS.

We now meet to advance, by discussion, our knowledge relating to safe and economical railway car interchange, the construction and maintenance of cars and shops, and to secure a thorough and uniform understanding of the M. C. B. rules. The cost of maintenance and operation of equipment has been and is on the increase and must receive the careful consideration of all car department employees. I would urge the members of this association first to be careful in reaching conclusions and that, secondly, we uniformly carry out the conclusions reached.

ADDRESS BY T. H. GOODNOW.

T. H. Goodnow, assistant superintendent car department, Chicago & North Western, addressed the association at the opening of the Tuesday afternoon session. Mr. Goodnow called attention to the importance of the association thoroughly discussing the M. C. B. rules of interchange with a view of getting the correct interpretation. He spoke of the necessity of thoroughly educating the car inspector in the correct interpretation of the rules. He greatly favored the joint inspection bureaus and predicted their general installation throughout the country. The general tendency of all the M. C. B. rules is becoming broader so as to make it easier to keep the freight moving towards its destination. He mentioned the bad effect that temporary repairs on interchange equipment had on the producing of bad order cars, stating further that he believed there would be still better agreements made within the next few years whereby more complete general repairs will be made to foreign cars. He closed his remarks by again emphasizing the necessity of carefully educating the inspectors in the yard.

DISCUSSION OF RULES.

The code of rules for interchange as adopted by the M. C. B. Association was discussed with a view of determining the correct interpretation of each rule, where there seemed to be any chance of misunderstanding. The following are the important conclusions reached under the various rules:

Rule 1. This rule was generally understood to mean that each road should conscientiously give all foreign cars the same care as to inspection, oiling, packing, adjusting brakes and running repairs that it gives to its own cars.

Rule 2. In regard to the first paragraph, many roads rely on the inspection of the receiving roads to determine defects, while others make their own inspection before delivering. Both practices have given satisfactory results.

In regard to paragraph *c*, many roads accept the improperly loaded car and transfer the load at the expense of the delivering line rather than turn the car back to the delivering line, thereby getting a more prompt delivery of the freight.

Rule 3. The second paragraph of this rule was believed by many to offer protection to the negligent car inspector, and it was thought that better results could be obtained by having this paragraph eliminated from the rules.

Rule 16. Under this rule it was believed to be permissible to make as heavy repairs as are required to place the car in good condition up to the extent of combination defects and to charge the delivering line or the owner as the case requires.

Rule 32. Under this rule the question of missing brake staffs on cars where they were removed for the accommodation of the lading was considered to be a delivering line defect, for when such cars are received, the inspectors should ascertain whether or not the brake staffs were with the car.

Rule 35. The stenciling of cars as mentioned in the third paragraph was taken to mean the date when the cars were rebuilt rather than when they were originally constructed.

Rule 39. The word "substitute" for draft timber was taken to mean any of the metal draft gears.

Rule 42. It was the consensus of opinion that two broken end posts and two corner posts are cardable defects.

Rule 43. Burned flooring or siding not able to be seen from the outside of the car and under the ordinary methods of inspection was considered as a "concealed fire damage."

Rule 60. In case of neglect to stencil the date of cleaning the various air brake parts, if those parts are recleaned on account of the date shown by the old stencil, the road performing the first cleaning cannot collect for the work done. In case it is necessary to clean those parts soon after they have been been cleaned by another road, a joint inspection should be made to determine whether the road that did the first cleaning or the owner should pay for the second cleaning.

Rule 68. It is understood that both wheels mentioned in the first paragraph shall be charged to the delivering company, even if the mating wheel has no slid flat spot.

Rule 105. A manufactured article was considered as one that was not included in the schedule and that would have to be purchased in the open market.

Rule 120. While this association appreciated that the rewording of this rule is in accordance with their suggestion, they believed it could be made stronger and serve better the results for which it is intended, by insisting in some way that requests for home route cars be given more prompt attention. A motion was passed requesting the Master Car Builders' Association to impress on the proper railway officers, "the importance of all roads throughout the country giving their immediate attention to requests for home route cards or for authority for dismantling cars, as it is found that such home route cards or authority for dismantling is being unduly delayed. This taken in conjunction with lack of proper storage room, is working seriously to the disadvantage of handling lines. Attention is also called to the fact that, in some cases, when cars reach the owner's line they are not repaired permanently, and it is respectfully recommended that owners give proper attention to such cars rather than permit them to again leave the home line with the same defects in existence."

It was understood that the per diem rates stop from the date of asking for home route cards. It was also understood that the car owner is obliged to pay for putting the car in sufficient repair for home routing.

It was also mentioned that car service *Rule 3*, paragraph F, was soon to be changed to coincide with the new rule.

The following addition to this rule was recommended to the Master Car Builders' Association: "If a car is found to have decayed or worn out parts which constitute an unfair usage combination under rules 37 to 42 inclusive, and if repairs are made without authority from the car owners, a joint evidence statement shall be furnished stating the actual condition of the car in accordance with rule 12, and this statement will be the authority for the company having such car in its possession to

make all necessary repairs and to bill the car owner for the cost of repairs, provided these repairs are necessary on account of defects due to ordinary wear and tear. The joint statement is to accompany the repair cards as authority for the bill." This change is suggested in order to facilitate prompt repairing of bad order cars and place the responsibility for these repairs where it properly belongs. Under the present rules and decisions the company having such a car in its possession must write the car owner for authority to repair before any repairs are made. This action results in seriously delaying bad order cars and also burdens the company handling the car with per diem charges which frequently amount to more than the cost of repairing the car.

Rule 14. In order to have uniform method for locating defects it was agreed to observe following system for underframe and superstructure. On a half of a car, the sides shall be designated right and left from a position facing the car at A end and the sides on the B half of the car shall be likewise designated from a position facing the car at B end.

Car service *Rule 15.* A great deal of trouble has been experienced by improper loading of open cars. An inspection at Chicago disclosed the fact that less than ten per cent. of such cars were loaded in accordance with the rule. It was believed that the shippers should be more carefully informed and be made to live up to the rules. The Chicago Car Interchange Bureau has a printed form requesting authority for reloading such cars which is sent to either the shippers or the delivering road, as the case may be. In some localities it is easier to force the shipper to conform to the rules, and it would be possible in all localities, if all the roads would enforce this rule as they should. It was also stated that box cars should be as carefully watched, as overloading often forces the car doors outside the clearance limits. At Buffalo an average of twelve hundred cars are reloaded per month.

It was stated that much more care should be exercised in placing proper car initials and numbers on repair cards. The yard inspectors are found to give the most trouble. When checked with work cards, corrections can often be made before much trouble has been caused.

One hundred and sixty-two members were registered and the sessions were well attended.

The following officers were elected for the ensuing year: F. C. Shultz, chief interchange inspector, Chicago, president; F. H. Hanson, assistant master car builder, Lake Shore and Michigan Southern, vice-president; S. Skidmore, foreman, car department, Big Four, secretary-treasurer.

DEFECTIVE APPLICATIONS OF BRAKE APPARATUS*

BY FRANK J. BORER,
Department Foreman, Central Railroad of New Jersey Shops, Elizabethport, N. J.

The problem of making cars more fire, water, burglar or fool proof, or to design them to prevent, or at least reduce the amount of damage both to the cars and the lading is the main issue among a large number of railway officers and employees. The writer will deal chiefly with defects in the brake system as existing on a great many cars to a greater or less extent, which, if remedied, would result in a large saving of money, and reduce the bad order car bills, especially those on account of damaged draft gears. To accomplish this, it is necessary to have absolutely reliable hand brakes at all times. Some of the most common defects are:

(1) Hand brake chain too long, causing fouling on brake staff barrel or drum especially if the piston travel exceeds 8 in.

(2) Hand brake chain too short, causing the brake shoes to drag on the wheels if the brake is adjusted to 5 in. piston travel, or less.

*Entered in the Car Department competition which closed February 15.

(3) Drum or barrel on brake staff too short, having the same effect as too long a brake chain.

(4) Hand brake chain sticking in hand brake chain sheave, especially when releasing the hand brake. This defect is often the designer's fault in not allowing sufficient clearance for the chain to pass through the sheave and the sheave bracket; or the designer may have had the drawing made for a 3/8 in. chain, but later some one may have applied a 1/2 in. chain.

(5) Lever guides and lever carriers designed too short or applied in a wrong manner, causing the levers to butt against the lever guides with a long piston travel when applying the hand or air brake, rendering it useless.

(6) Hand brake chain applied to the wrong side of the brake staff, causing the chain to stick by striking against the brake staff supporting bracket.

(7) Poor hook on hand brake rod allowing the chain to disengage itself from the rod.

(8) Insufficient clearance around the pipes where they pass through holes in the sills, there not being enough allowance for the expansion of the steam pipes or a little shifting of either steam or air pipes. The same may be said of angle cocks applied snug against the end sills of cars without any clearance between the end sill and the angle cock.

(9) Branch pipe connections to the triple valve made too rigid, causing leaks, broken check valve cases and broken pipes, whenever the car receives a shock. The designer and builder have often overlooked the fact that branch pipes ought to be run so as to relieve the triple valve of any strain, if the train line should shift one or two inches. On account of many centrifugal dust collectors freezing up and bursting during cold weather and in order to keep moisture out of the triple valves, branch pipe connections ought to be taken out of the top of train line instead of from the bottom as is usual.

(10) On passenger equipment cars, low pressure gas feed pipes, the car discharge valve pipe and the pipe leading to the conductor's valve ought to be galvanized, especially where they pass through the floors, as they will last much longer.

(11) Some designers of freight cars seem to have entirely disregarded the matter of easy accessibility for clearing and repairing the triple valve and brake cylinder. These parts are placed close against steel sills on some cars making it extremely hard to make proper repairs.

In conclusion, if we expect a man to do good work we must give him a chance. We must make the conditions under which he works as favorable as we can. This applies to the air brake repairman as well as to the brakeman. Let the former put the brake in a good condition and the latter will not damage so many cars in the yards in the course of shifting. Let the designer, the foreman, the repairman, the yardmaster and the brakeman co-operate with one another for the common good of our employers and ourselves, and many existing defects in car construction may be remedied or avoided without any difficulty.

Extinguishing Forest Fires.—Ammonia bombs are being tried out on some of the national forests for the purpose of extinguishing forest fires. They are said to have worked well in the case of brush fires where the fire-fighters find difficulty in getting near enough to the burning area to beat out the flames. Each bomb exploded will extinguish fire in a circle of about five yards in diameter.

Over-Specialization.—Over-specialization often leads to undue emphasis upon the importance of individual tasks in given departments; to a lack of interest outside immediately vital responsibilities; to long continued employment at stated compensation perhaps, and not seldom to final replacement before middle age is past by men with less experience in single grooves but with better comprehension of inter-departmental relations and the ability to make effective use of men with limited ideas.—*Power.*

STUDY OF CAR WHEEL FLANGES AND TREADS

High Frictional Resistance Results from Non-Mating and Poor Flanges—Cast Steel Wheels and Coning Good.

BY L. W. WALLACE,

Assistant Professor Car and Locomotive Design, Purdue University

The discussions of the report of the standing committee on car wheels at the last three conventions of the Master Car Builders' Association have been read with much interest by the writer. That portion pertaining to the contour of the tread of the wheels was of most interest. It is surprising to note the wide divergence of opinion as to the value or non-value of coning, and also the very evident lack of actual knowledge of just what influence the condition of the flange and tread of a car wheel has on flange friction. The writer first became interested in this matter and began to make a study of it while associated with the truck tests* made for the American Steel Foundries during the summers of 1910 and 1911, and since that data has been published a careful analysis of it has been made from the standpoint of the wheels. It is proposed to here submit the results of that analysis, in the hope of adding some information to the discussion and to indicate a possible means of determining by experimental methods just what wheel contour is best adapted to American railway practice.

THE DATA.

All of the data used as a basis of this discussion was that published in "Some Experiments with Freight Car Trucks," Volume II, by Professor Louis E. Endsley. That portion of the data obtained when an Andrews side frame truck was tested was used for the purpose of determining to what extent that truck resistance was increased by defective wheels. The truck from which the data was obtained was of standard design, with the exception that it had a heavier bolster than commonly used. By using the heavy bolster and loading the truck with a large steel casting, the weight of the truck as tested was made equivalent to the light weight on a truck of a fifty-ton car.

As access may be had to the complete report of the tests upon which this discussion is based, it is not necessary to go into details as to how the data was obtained and worked up. But since the object of this paper is to show in what manner and to what extent frictional resistance is influenced by the condition of wheel treads and flanges, a rather detailed description of the wheels will be given.

WHEELS USED.

Thirty-two different wheels were used in such combinations as to make the ten sets designated in Table I. The wheels used in seven of the sets were cast iron, and those used in the remaining three sets were Davis cast steel wheels. Table I gives the main facts with reference to the wheels, and Figs. 1 to 10 inclusive show the wheel contours, as obtained by means of a wheel contour recorder. In order to show clearly the condition of the wheel flanges and treads, there was superimposed upon each wheel outline the standard M. C. B. contour. This was done in the following manner: The contour recorder drew the straight line shown in the diagrams, marked "parallel to the base line"; this line was parallel to the axle. In applying the standard contour, its base line was made parallel to the base line of the wheel contour and the gaging point of the M. C. B. standard contour was brought in contact with the wheel's gaging point in the same manner as the regulation wheel defect gage is used. The space between the outer line and the inner one, in each case, indicates in what manner and to what degree the contours of the wheels tested had been worn. It is evident from this exhibit that as wide a variation in wheel conditions as is ordinarily met with in practice was

TABLE 1.

Set. I	Wheel No. II	Service condition. III	Kind of wheel. IV	Tape. V	Date made. VI	Weight, lbs. VII	Total weight of truck and wheels as tested. VIII
A	1	Mated, new (ground)	C. I.	1/32" under 33"	7-29-10	715	22,610
A	2	Mated, new (ground)	C. I.	1/32" under 33"	7-28-10	715	
A	3	Mated, new (ground)	C. I.	1/32" over 33"	8- 2-10	715	
A	4	Mated, new (ground)	C. I.	1/32" over 33"	8- 2-10	715	
B	1	Non-mated, new.....	C. I.	1/16" under 33"	9-21-99	650	22,400
B	2	Non-mated, new.....	C. I.	1/16" over 33"	9-23-99	650	
B	3	Non-mated, new.....	C. I.	1/8" over 33"	11- 8-99	650	
B	4	Non-mated, new.....	C. I.	3/8" over 33"	11- 3-99	650	
C	1	Mated, new, Davis...	C. S.	3/4" over 33"	8-17-10	612	22,200
C	2	Mated, new, Davis...	C. S.	3/4" over 33"	5-18-10	612	
C	3	Mated, new, Davis...	C. S.	13/16" over 33"	8-20-10	612	
C	4	Mated, new, Davis...	C. S.	13/16" over 33"	7-14-10	612	
D	1	Mated, med., new....	C. I.	13/16" under 33"	9-20-05	700	22,550
D	2	Mated, med., new....	C. I.	13/16" under 33"	9-20-05	700	
D	3	Mated, med., new....	C. I.	3/16" under 33"	8-21-05	700	
D	4	Mated, med., new....	C. I.	3/16" under 33"	8-21-05	700	
E	1	Non-mated, med., new	C. I.	13/16" under 33"	9-20-05	700	22,550
E	2	Non-mated, med., new	C. I.	3/16" under 33"	8-21-05	700	
E	3	Non-mated, med., new	C. I.	13/16" under 33"	9-20-05	700	
E	4	Non-mated, med., new	C. I.	3/16" under 33"	8-21-05	700	
F	1	Mated, old	C. I.	1 1/8" under 33"	5-17-02	650	22,400
F	2	Mated, old	C. I.	1 1/4" under 33"	8-20-02	650	
F	3	Mated, old	C. I.	3/4" under 33"	4-15-04	650	
F	4	Mated, old	C. I.	13/16" under 33"	8-15-06	650	
G	1	Non-mated, old	C. I.	15/16" under 33"	11-22-02	600	22,400
G	2	Non-mated, old	C. I.	3/8" under 33"	11- 5-07	700	
G	3	Non-mated, old	C. I.	15/16" under 33"	3- 8-06	650	
G	4	Non-mated, old	C. I.	5/8" under 33"	5- 4-07	650	
H	1	Non-mated, med., old	C. I.	1/8" under 33"	3-18-07	700	22,550
H	2	Non-mated, med., old	C. I.	1/8" under 33"	3-18-07	700	
H	3	Non-mated, med., old	C. I.	1" under 33"	2- 5-06	700	
H	4	Non-mated, med., old	C. I.	1/2" under 33"	12-22-06	700	
I	1	Special, Davis, mated	C. S.	1.21" under 33"	5-16-11	576	22,200
I	2	Special, Davis, mated	C. S.	1.21" under 33"	5-16-11	577	
I	3	Special, Davis, mated	C. S.	1.18" under 33"	7-19-11	581	
I	4	Special, Davis, mated	C. S.	1.18" under 33"	7-19-11	591	
J	1	Special, Davis	C. S.	1.12" under 33"	5-16-11	576	22,200
J	2	Special, Davis	C. S.	1.21" under 33"	5-16-11	577	
J	3	Special, Davis	C. S.	1.11" under 33"	7-19-11	581	
J	4	Special, Davis	C. S.	1.18" under 33"	7-19-11	591	

used. The special characteristics of each set of wheels are as follows:

Set A. The wheels in this set were new cast iron with contours ground in order to obtain as nearly the M. C. B. standard as possible; from Fig. 1 it is evident that there was a close similarity in the two contours.

Set B. The wheels in this set were cast iron and will be referred to as non-mated new wheels. One pair of these wheels had a difference in tape measurement of 1/8 in., and the other pair had a difference in tape measurement of 1/4 in. The two large wheels were on the same side of the truck. It is evident from Fig. 2 that the contours of this set of wheels were good.

Set C. The wheels in this set were Davis cast steel with contours ground to the M. C. B. standard. A comparison of the contours and that of the standard is shown in Fig. 3. The wheels on each axle were perfectly mated.

Set D. The wheels in this set were mated cast iron wheels, and they will be referred to as medium new wheels. To what

*American Engineer & Railroad Journal, May, 1911, page 193, and November, 1911, page 455.

extent they were worn is shown in Fig. 4. Wheels 3 and 4, which were on the same axle, were ⅝ in. larger than wheels 1 and 2 on the other axle.

Set E. The wheels in this set were the same as those used in Set D, and their contours are shown in Fig. 5. The mated condition prevailing in Set D was converted into the non-mated medium new set E by placing wheel 2 of Set D on the same axle as wheel 4, thus forming 3 and 4 of Set E. In like manner wheel 3 of Set D was placed on the same axle with wheel 1, thus forming pair 1 and 2 of Set E. The above mentioned change made the wheels on one side of the truck ⅝ in. larger than on the opposite side.

Set F. The wheels in this set were cast iron and will be referred to as mated old. Although they were not exactly mated, yet they were nearly enough so to be classed as such when considered in connection with their sharp flanges which are clearly shown in Fig. 6. Wheels 3 and 4 were approximately 7/16 in. larger than wheels 1 and 2.

Set G. The wheels in this set were cast iron and will be referred to as non-mated old. The contours were not good, as is obvious from Fig. 7. There was a difference of 9/16 in. in the circumference of wheels 1 and 2, and ½ in. in the circumference of wheels 3 and 4. The large wheels were on the same side of the truck.

Set H. The wheels in this set were cast iron and they will be referred to as non-mated medium old. There was a difference of ½ in. in the circumference of wheels 3 and 4, and wheels 1 and 2 were mated. Their contours are shown in Fig. 8.

Set I. The wheels in this set were Davis cast steel wheels and will be referred to as special mated Davis. These wheels were made with a height of flange of ¾ in., and with no coning on the treads, as is evident from Fig. 9.

Set J. The wheels in this set are the same as those used in Set I, and the contours of their flanges and treads are shown in Fig. 10, the only difference between the two sets being in a very slight non-mating condition prevailing in Set J.

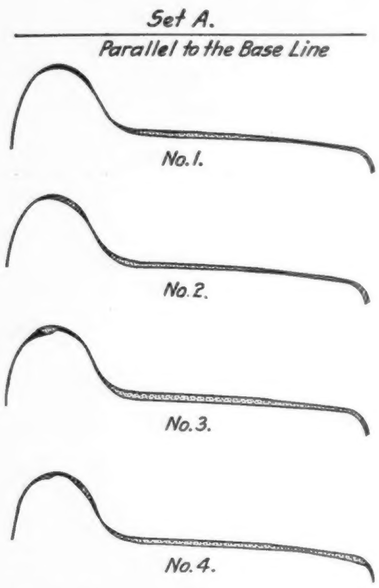


Fig. 1—Set A; Mated New Cast Iron Wheels, Ground.

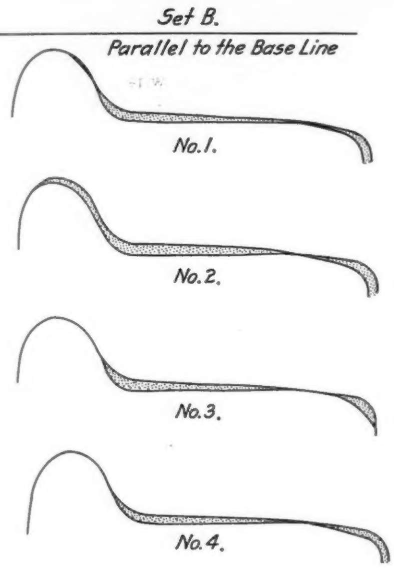


Fig. 2—Set B; Non-mated New Cast Iron Wheels.

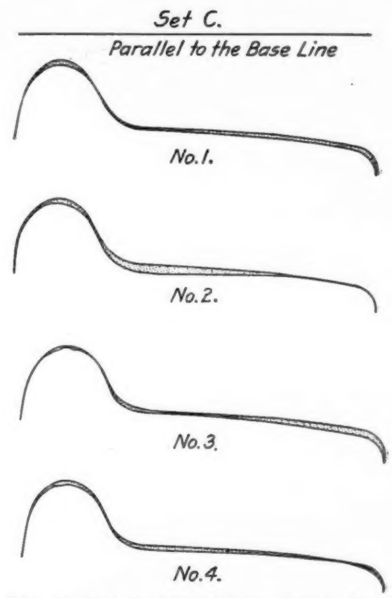


Fig. 3—Set C; Mated New Davis Cast Steel Wheels.

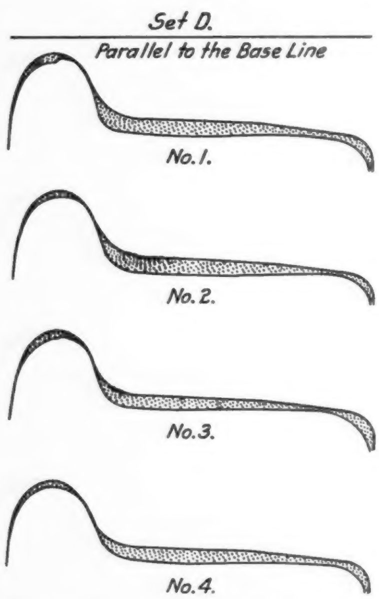


Fig. 4—Set D; Mated Medium New Cast Iron Wheels.

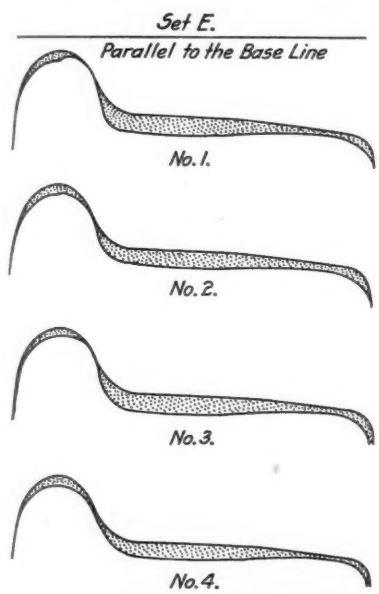


Fig. 5—Set E; Non-mated Medium New Cast Iron Wheels.

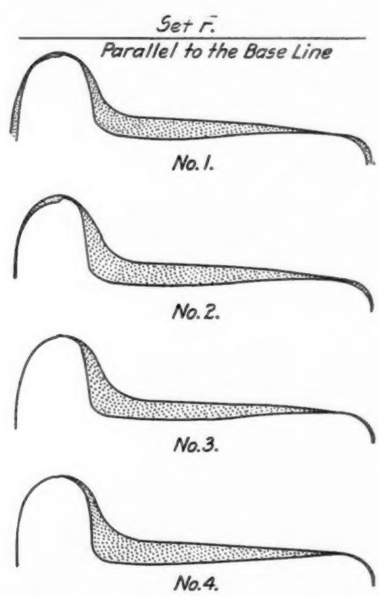


Fig. 6—Set F; Mated Old Cast Iron Wheels.

DISCUSSION OF RESULTS.

An examination of the value of the resistance in pounds per ton for all tests made with the Andrews side frame trucks

showed that of all wheels used, the mated Davis cast steel gave the least resistance. Therefore, in the further study of this subject, the mated Davis cast steel wheels, designated as Set C, will be taken as a basis of comparison. This comparison is not to be taken as absolute, as only one set of Davis steel wheels was used; consequently data obtained from more sets might indicate something different. But within the limits of the data at hand, such a comparison as will be made as Set A, were used. The resistance in pounds per ton for both Set C and Set A are given in Table 2.

TABLE 2.

COMPARISON OF SETS C AND A.

Track.	Tangent.	3 Deg.	6 Deg.	12 Deg.
Resistance in lbs. per ton for Set A.	9.8	11.1	12.4	17.5
Resistance in lbs. per ton for Set C.	5.0	6.0	6.9	12.5
Lbs. in favor of Set C.............	4.8	5.1	5.5	5.0
Per cent. in favor of Set C.........	48.9	45.9	44.3	28.5

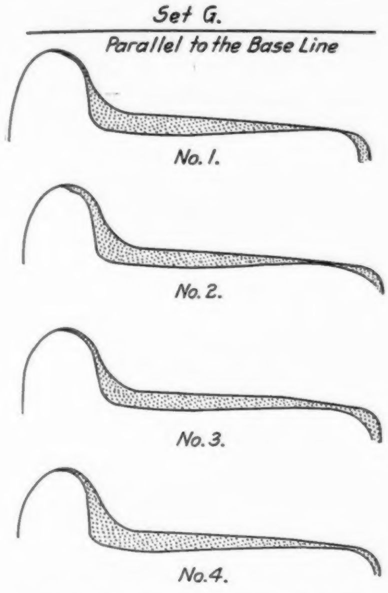


Fig. 7—Set G; Non-mated Old Cast Iron Wheels.

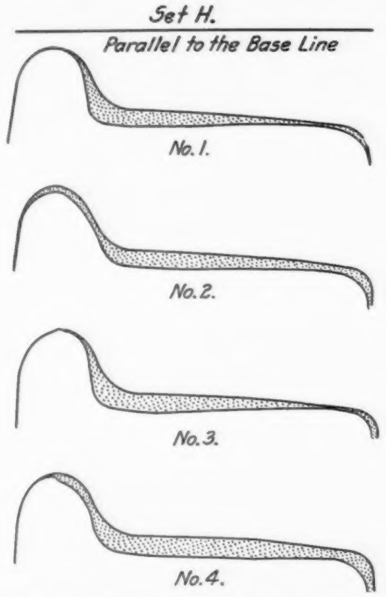


Fig. 8—Set H; Non-mated Medium Old Cast Iron Wheels.

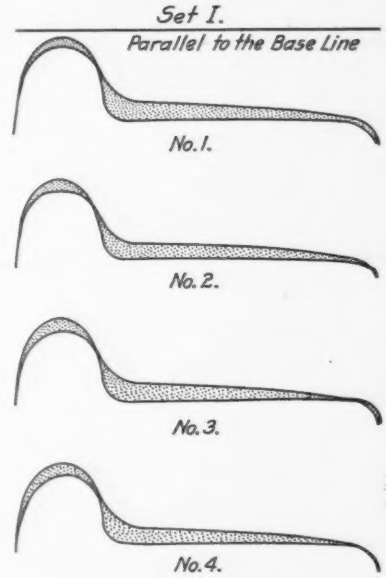


Fig. 9—Set I; Special Davis Mated Cast Steel Wheels.

is justifiable. To this end, the average resistance in pounds per ton for each truck was determined for this set of wheels, which values are as follows: Tangent track, 4.96 lbs. per ton; 3-deg. 5.37 lbs. per ton; 6-deg. 6.38 lbs. per ton, and 12-deg. 12.52 lbs. per ton. These values were plotted as shown in Line 1 of Fig. 11. It is to be noted that the slope of the line gradually increases up to 6 deg. curvature, and from that point to 12 deg., the slope was more pronounced. The lower line in Fig. 11 appears as such in all the succeeding diagrams.

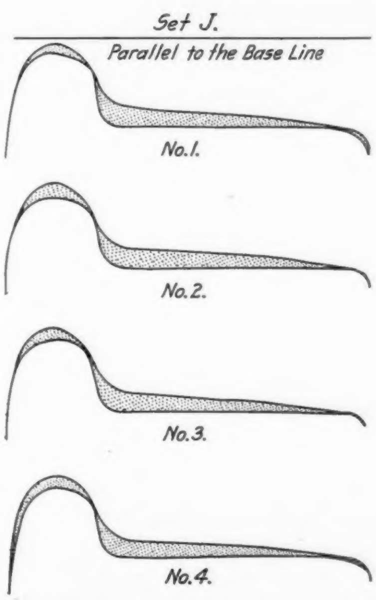


Fig. 10—Set J; Slightly Non-mated Davis Cast Steel Wheels.

Set A. Line 2 in Fig. 11 was plotted from the average resistance obtained when the mated cast iron wheels, designated

From the percentages given in the last line of the table, it is evident that the mated cast iron wheels gave a much higher frictional resistance than the mated cast steel wheels. It was expected that there would be a difference in the frictional resistance of cast steel and cast iron wheels, but such a large difference was not anticipated, and the problem of assigning a reason for this great difference became more difficult when it was found that the mated cast iron wheels with good contours gave a higher frictional resistance than did two sets of non-

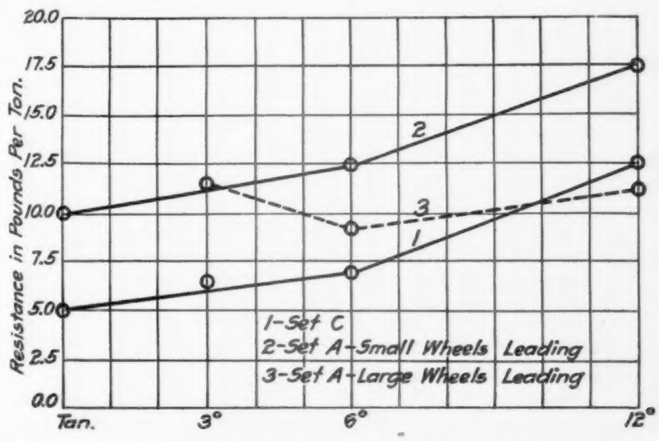


Fig. 11—Average Resistance of Sets A and C on Different Tracks.

mated wheels with contours not so good. At this time, and with the data at hand, no satisfactory explanation can be given for the action of the mated cast iron wheels.

Another interesting feature is shown by the dotted line 3 in Fig. 11. In conducting the work, a series of tests was made with wheels 1 and 2 leading, and another series with 3 and 4 leading. Reference to Table 1 will show that wheels 3 and 4 were larger in circumference than were wheels 1 and 2. It was found that the average resistance in pounds per ton for

the series with the large wheels leading was less than when the small wheels were leading, as the dotted line in Fig. 11 shows.

Set B. The lines 2 and 3 in Fig. 12 show the relation that existed between frictional resistance and degrees of curvature when Set B was used. Two series of tests were made, one being with the large wheels on the outside rail of the curve, and the other with the large wheels on the inner rail. Line 2

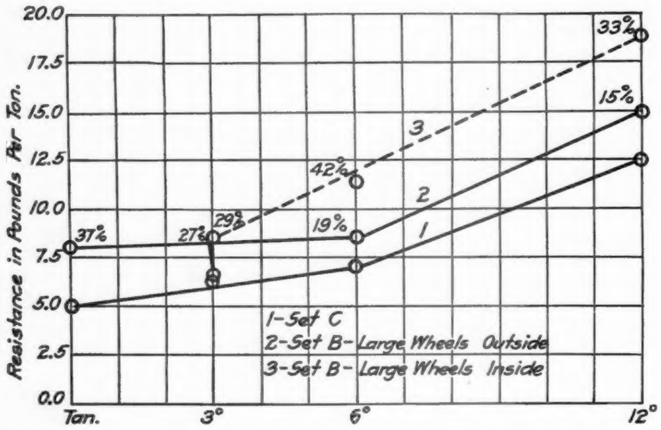


Fig. 12—Comparative Frictional Resistance of Sets B and C on Different Tracks.

represents the results obtained when the large wheels were on the outer rail, and line 3 when the large wheels were on the inner rail. It is obvious from the relative position of lines 2 and 3 that the friction was considerably higher when the large wheels were on the inside of the curve than when on the outside. Table 3 shows the higher friction obtained when the large wheels were on the inside of the curve.

TABLE 3.

Track.	3 Deg.	6 Deg.	12 Deg.
Resistance in lbs. per ton—large wheels inside.	8.5	12.0	18.8
Resistance in lbs. per ton—large wheels outside	8.25	8.5	14.75
Lbs. in favor of large wheels outside..........	.25	3.5	4.05

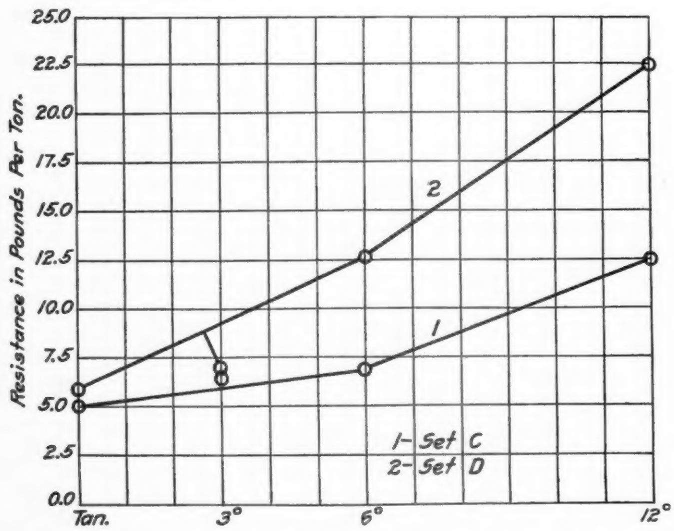


Fig. 13—Comparative Frictional Resistance of Sets C and D on Different Tracks.

Set D. The curve for the medium new wheels D, Fig. 13, is similar in character to the other diagrams. The values in Table 4 show to what extent the friction for this set of wheels differed from those of Set C.

TABLE 4.

COMPARISON OF SET C AND SET D.

Track.	Tangent.	2 Deg.	6 Deg.	12 Deg.
Resistance in lbs. per ton, Set D....	5.75	9.1	12.6	22.4
Resistance in lbs. per ton, Set C....	5.0	6.0	6.9	12.5
Lbs. in favor of Set C..............	.75	3.1	5.7	9.9
Per cent. in favor of Set C.........	13.0	34.0	45.2	44.1

Set E. The curve for Set E, Fig. 14, does not differ in its general tendency from that for Set D. It is also obvious from the values in Table 5 that the friction for the non-mated wheels E is approximately the same as for wheels D, with the exception of the tangent track friction, whereon the Set E gave a

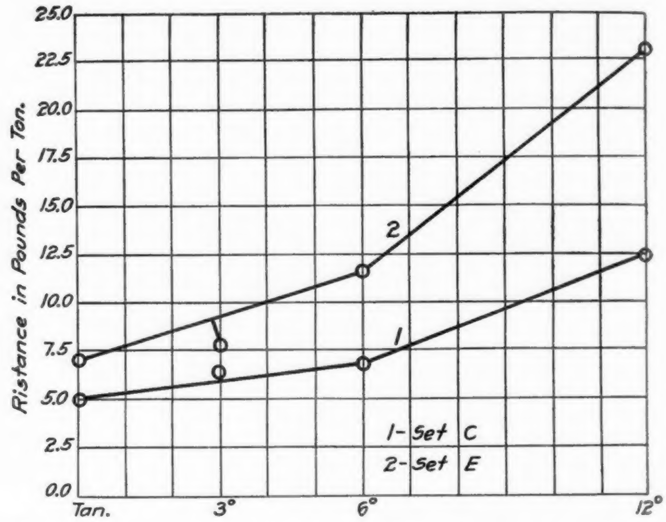


Fig. 14—Comparative Frictional Resistance of Sets C and E on Different Tracks.

higher resistance. The Set E was so tested as to have the large wheels on the inside of the curve, which gave a higher frictional resistance than there would have been had the large wheels been on the outside of the curve. The reason for the comparatively low friction for Set E, which were non-mated

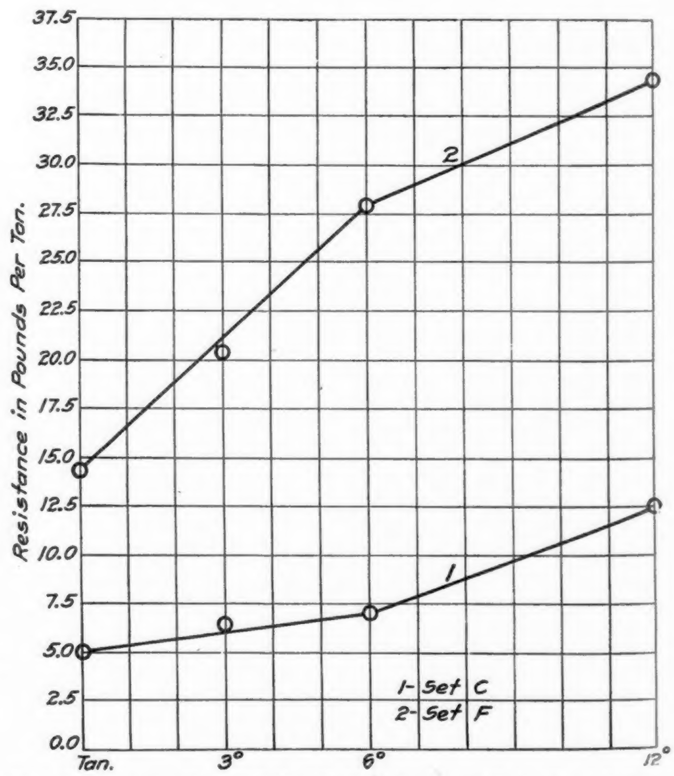


Fig. 15—Comparative Frictional Resistance of Sets C and F on Different Tracks.

to the extent of ⅝ in., as compared with Set D, the same wheels as E, but mated, is due to the fact that the condition of testing on the 6-deg. and 12-deg. tracks was not the same for the two different sets of wheels. On the two tracks mentioned, Set E was tested at 19 miles an hour, whereas Set D

was tested at 23 miles an hour. This difference in initial speed no doubt accounts for the low friction of Set E.

TABLE 5.

COMPARISON OF SETS C AND E.

Track.	Tangent.	3 Deg.	6 Deg.	12 Deg.
Resistance in lbs. per ton, Set E....	7.0	9.25	11.6	23.0
Resistance in lbs. per ton, Set C....	5.0	5.0	6.9	12.5
Lbs. in favor of Set C..............	2.0	3.25	4.7	10.5
Per cent. in favor of Set C.........	28.5	35.1	40.5	45.6

Set F. Reference to Fig. 6 will show that the wheels in Set F had very bad flanges and that they were not mated. To what extent this wheel condition influenced the frictional resistance is obvious from the curves in Fig. 15, and from the percentages recorded in Table 6.

TABLE 6.

COMPARISON OF SETS C AND F.

Track.	Tangent.	3 Deg.	6 Deg.	12 Deg.
Resistance in lbs. per ton, Set F....	14.4	24.0	27.75	34.3
Resistance in lbs. per ton, Set C....	5.0	6.0	6.9	12.5
Lbs. in favor of Set C..............	9.4	18.0	20.85	21.8
Per cent. in favor of Set C.........	65.2	75.0	75.1	63.5

Set G. The wheels in Set G were non-mated and were so mounted that the two larger wheels were on the same side of the truck. The points on line 2 in Fig. 16 were plotted by taking an average of the resistance in pounds per ton for all runs made with the large wheels on the outside rail of the curved tracks and the broken line 3 represents the relation between degrees of curvature and frictional resistance when the large wheels were on the inner rail of the curved tracks. As has been shown in a preceding paragraph, the friction is materially increased by the use of non-mated wheels, and for

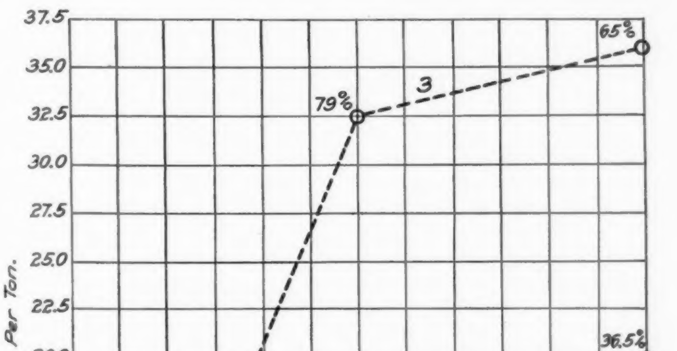


Fig. 16—Comparative Frictional Resistance of Sets C and G on Different Tracks.

the same wheels the frictional resistance is much larger when the large wheels are on the inside rail.

The values given in Table 7 clearly demonstrate this point, as do the curves.

TABLE 7.

Track.	3 Deg.	6 Deg.	12 Deg.
Resistance when large wheels were on inside...	14.9	32.6	35.8
Resistance when large wheels were on outside rail	11.7	13.4	19.7
Lbs. in favor of large wheels outside..........	3.2	19.2	16.1

Set H. There was a peculiar combination of wheel conditions in Set H. The pair composed of wheels 1 and 2 was mated, whereas 3 and 4 were non-mated, wheel 3 being smaller than 4 by ½ in. It is also to be noted that the wheels on the same side of the truck were not mated, that is, wheel 3 was ⅞ in. smaller than wheel 2. This peculiar condition no doubt accounts for the inconsistent results plotted for line 2 in Fig. 17. The points for the 3-deg. and 6-deg. curves do not fall in their proper relation to the other points, as has been true for other wheels. The line 2, which represents the relation between degrees of curvature and frictional resistance, was drawn straight because in another feature of the tests conducted, it was found

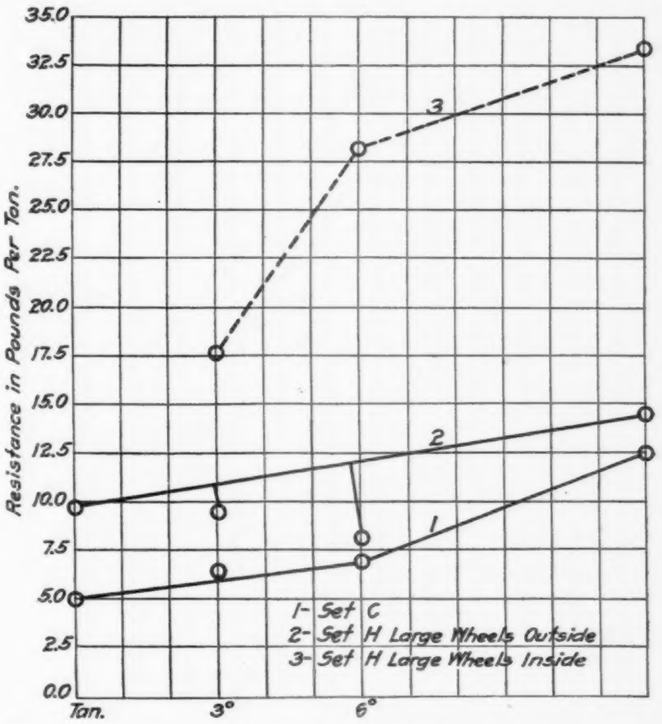


Fig. 17—Comparative Resistance of Sets C and H on Different Tracks.

that this relation for all wheel conditions could be represented by a straight line.

Set I. A comparison of wheel sets C and I is of especial importance, since they were made of the same material, so that any difference that is evident may be taken as directly due to a variation in wheel conditions. The wheels in Set I had all of the coning removed and the flange ground to an approximate height of ¾ in. This is clearly shown in Fig. 9. The curves plotted in Fig. 18 and the values tabulated in Table 8, serve to emphasize the importance of coning. With wheels identical in every regard, except that one set has the normal coning and the other has all coning removed, the wheels with no coning gave from 60 to 70 per cent. more friction.

TABLE 8.

COMPARISON OF SETS C AND I.

Track.	Tangent.	3 Deg.	6 Deg.	12 Deg.
Resistance in lbs. per ton, Set I....	14.6	19.4	24.1	33.6
Resistance in lbs. per ton, Set C....	5.0	6.0	6.9	12.5
Lbs. in favor of Set C..............	9.6	13.4	17.2	21.1
Per cent. in favor of Set C.........	65.7	69.0	71.3	62.8

Set J. The wheels used in Set J were the same as those used in Set I, with the exception that they were ground so as to be slightly non-mated. The difference in mating was so slight, however, that the results were not materially influenced thereby.

It is obvious from the comparison made between Set C and Sets I and J that the removal of the coning greatly increased the frictional resistance.

To summarize the comparisons that have been made for each

set of wheels with Set C, and to show the relative merits of each set, the diagrammatic exhibit in Fig. 19 is shown. The values plotted are the average resistances in pounds per ton for all runs made on all tracks, for each set of wheels. It is obvious from this diagram that the mated cast steel wheels gave a lower resistance than any other set of wheels. A careful study of the wheel conditions as set forth in Table 1 and as portrayed in the exhibit of wheel contours, confirms the statement that the results as shown in Fig. 19 are entirely con-

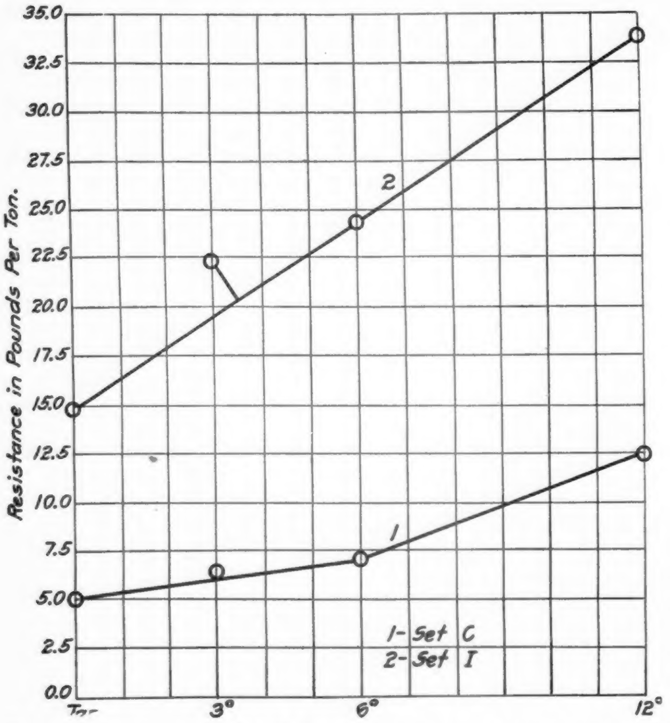


Fig. 18—Comparative Frictional Resistance of Sets C and I on Different Tracks.

sistent with the exception of Set A. As before mentioned herein, no reason can be assigned as to why the mated wheels of Set A gave such high resistance.

SUMMARY.

In order to make a more general analysis, the sets of wheels were grouped into five groups as follows: Group 1, designated as mated and composed of Sets A, C and D; Group 2, designated as non-mated new and medium new, and composed of Sets B and E; Group 3, designated as medium old and com-

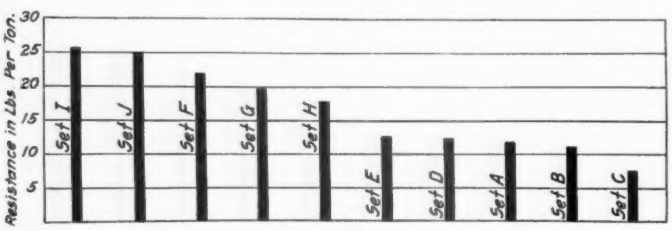


Fig. 19—Average Resistance Obtained for all Tests on the Four Tracks.

posed of Set H; Group 4, designated as non-mated old and composed of Sets F and G; Group 5, designated as special no-coning and composed of Sets I and J.

The resistance in pounds per ton for each group was averaged and the results plotted as shown in Fig. 20. It is obvious from these curves that the condition of the mating and of the contours of the wheels has a very important bearing upon the frictional resistance. It is also important to here call attention to the fact that all of the plotted points for the 3-deg. curve fell below the general tendency of the line for the other three tracks. This is particularly noticeable in Fig. 20, but it also appeared in almost all of the curves for the individual sets of wheels. This is no doubt due to the fact that for a 3-deg. curve there is sufficient coning of the wheels to compensate for the difference in length between the outer and inner rails of the track, but that at some point between a 3-deg. and 6-deg. curve, there is not sufficient coning; therefore, the friction for any degree of curvature beyond that point increases at a greater ratio.

The numerical values for the several groups as obtained from the curves in Fig. 20, are given in Table 9.

TABLE 9.

AVERAGE RESISTANCE IN POUNDS PER TON, FOR EACH GROUP.

Group.	Track. Tangent.	3 Deg.	6 Deg.	12 Deg.
1—Sets A, C, D	5.8	8.5	10.1	16.5
2—Sets B, E	7.5	9.2	10.8	20.0
3—Set H	9.7	13.6	17.4	25.0
4—Sets F, G	12.2	18.7	25.3	31.0
5—Sets I, J	14.2	21.2	28.2	36.0

A diagrammatic comparison of the five groups is shown in Fig. 21. The average resistance in pounds per ton for all four

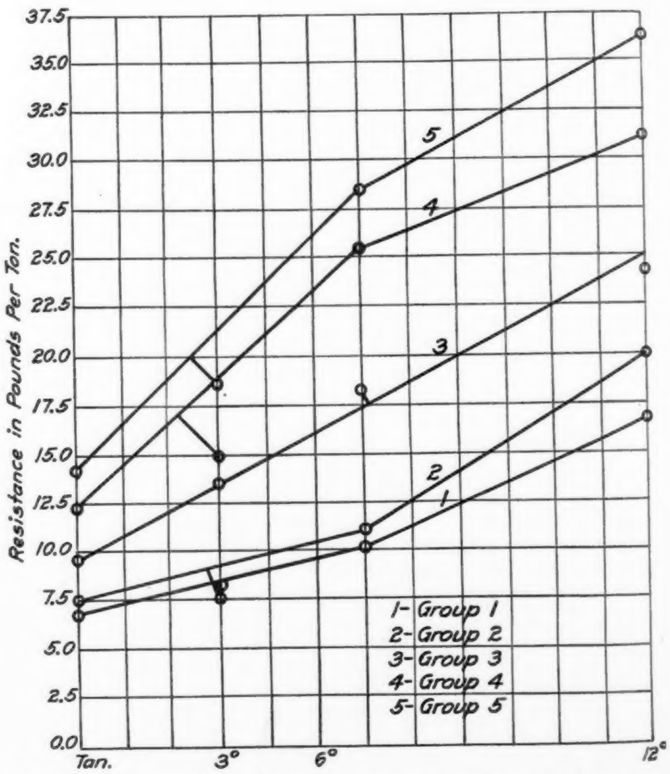


Fig. 20—A Comparison of the Resistance According to Groups as Shown on Table 9.

tracks as given in Table 9 was determined for each group of wheels, and these averages plotted as shown. This diagram indicates that the two first groups gave a comparatively low resistance. This is easily accounted for because the flanges and treads of the first two groups of wheels were what would be termed as in good condition. The three remaining groups of wheels, as is evident from the diagram and curves, produced considerably more friction than the first two groups, which is due to high and sharp flanges, and to the absence of coning. The friction for the two worst groups is 112 per cent. higher than for the two best groups. For this reason, wheels should have as near perfect contours of flanges and treads as it is practicable to make them, and it is very essential that only wheels of like tape measurement be mounted upon the same axle. It is very important to notice that the highest resistance obtained, notwithstanding some of the wheels had very sharp flanges, was recorded for wheels with no coning.

CONCLUSIONS.

From a study of the data obtained upon four different tracks and while using ten different sets of wheels, the following conclusions seem to be justified:

First.—Wheels should be exactly mated in order that frictional resistance be a minimum.

Second.—Mated cast steel wheels will give less resistance than any condition of cast iron ones. The per cent. in favor of the mated cast steel wheels over the results obtained from the two best sets of cast iron wheels was 35. All of this gain in per cent. may not be directly due to difference of wheels, because there may have been more journal friction on some of the sets than others. But since due precautions were taken to insure the minimum amount of journal friction in every case, it is thought that the greater portion of the per cent. in favor of the cast steel wheels is due to the difference of material out of which the wheels were made. It is regretted that more of the mated cast steel wheels were not tested in order that more data for comparison with the other wheels tested might be available.

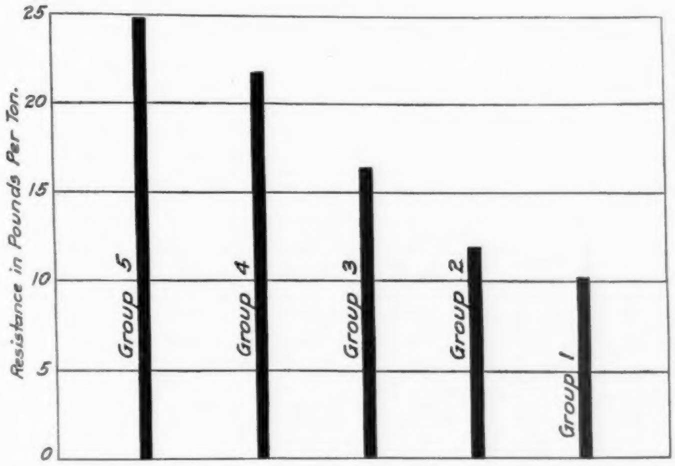


Fig. 21—Average Resistance for Each Group on the Four Tracks.

Third.—Wheels with sharp and high flanges, as Set F, give 123 per cent. more friction than wheels with comparatively good flanges, as Set B.

Fourth.—The coning on wheels is of great value in reducing flange friction on curved tracks. It was found that the greatest friction obtained for any test was for wheels which had all the coning removed.

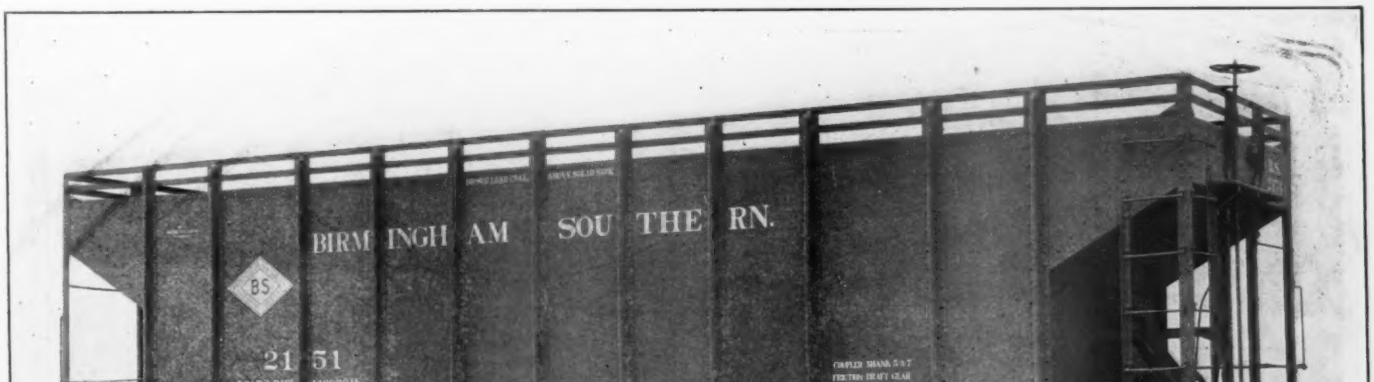
In view of the importance of the subject and since the data herein submitted throws some light upon the problem, it seems that a detailed and exhaustive investigation should be made to determine the best contour of wheel treads and flanges. The writer is of the opinion that such an experimental plant as was used at Granite City by the American Steel Foundries for the truck tests would be suitable for making a thorough investigation of the proper coning to use and to investigate other questions concerning wheel treads and flanges.

SEVENTY-TON HOPPER CAR

The Birmingham Southern recently received from the Pressed Steel Car Company, Pittsburgh, Pa., 80 hopper cars of 70 tons capacity. These weigh 58,600 lbs., 38,700 lbs. of which is in the body and 19,900 lbs. in the trucks; this is considerably more weight than would ordinarily be necessary for a 70-ton car of ample strength, but these cars have been built to withstand very severe service. They have a capacity level full of 2,840 cu. ft., and with a 10 in. average heap, of 3,157 cu. ft. The ratio of the paying load to the total weight of the loaded car is 72½ per cent. The general dimensions of the cars are as follows:

Length over striking plates	41 ft. 8 in.
Length over end sills	41 ft. 3½ in.
Length inside	40 ft. 0 in.
Distance center to center of trucks	32 ft. 0 in.
Width over side stakes	10 ft. 1⅝ in.
Width inside of body	9 ft. 6 in.
Height, rail to top of coke rack	12 ft. 0½ in.
Height, rail to top of brake mast	12 ft. 9 in.
Length of drop doors in clear	about 3 ft. 6⅞ in.
Width of drop doors in clear	about 3 ft. 4¾ in.

The cars are equipped with 16 drop doors, made of ⅜ in. pressed plates reinforced by flanges and operated by the "Lind" door gear, which is self-locking and when the doors are closed guards against the accidental discharge of the lading. The total door area is 97 sq. ft., and the hopper sheets are 5/16 in. thick. The trucks are of the arch bar type with 6 in. x 11 in. journals and are equipped with Reliance truss type bolsters, pressed channel brake beams, rolled steel wheels and adjustable side bearings.



Seventy-Ton Capacity Car with Four Hoppers.

The car body is designed to carry a uniformly distributed load of 154,000 lbs. The body bolsters are built integral with the underframe, each bolster consisting of a web plate made of ⅜

in. open hearth steel with a cast steel center brace, reinforced at the top by a ½ in. plate, and at the bottom with four 3½ in. x 3½ in. x 7/16 in. angles. The body center plates are cast steel and the side bearings pressed steel. There are three cross ridges of ¼ in. plate reinforced at the top by 3 in. x ½ in. bars, and at the bottom by 6 in. x 3½ in. x 7/16 in. angles. Four diagonal braces are used, consisting of 6 in., 10.5 lb., channels extending between the bolsters and the end sills. The two center sills consist of 12 in., 40 lb., channels extending from end sill to end sill and are tied together and reinforced at the top by a 19⅜ in. x ¼ in. plate. The end sills are 12 in., 20.5 lb., channels reinforced at the top by 3/16 in. pressed plates, and at the coupler opening by a cast steel striking plate to which is bolted the malleable iron coupler carrier. The junction of the end sill and the side of the car is reinforced by a malleable iron push pole pocket. The side sills are 10 in., 15 lb., channels, and extend from the bolsters to the end sills.

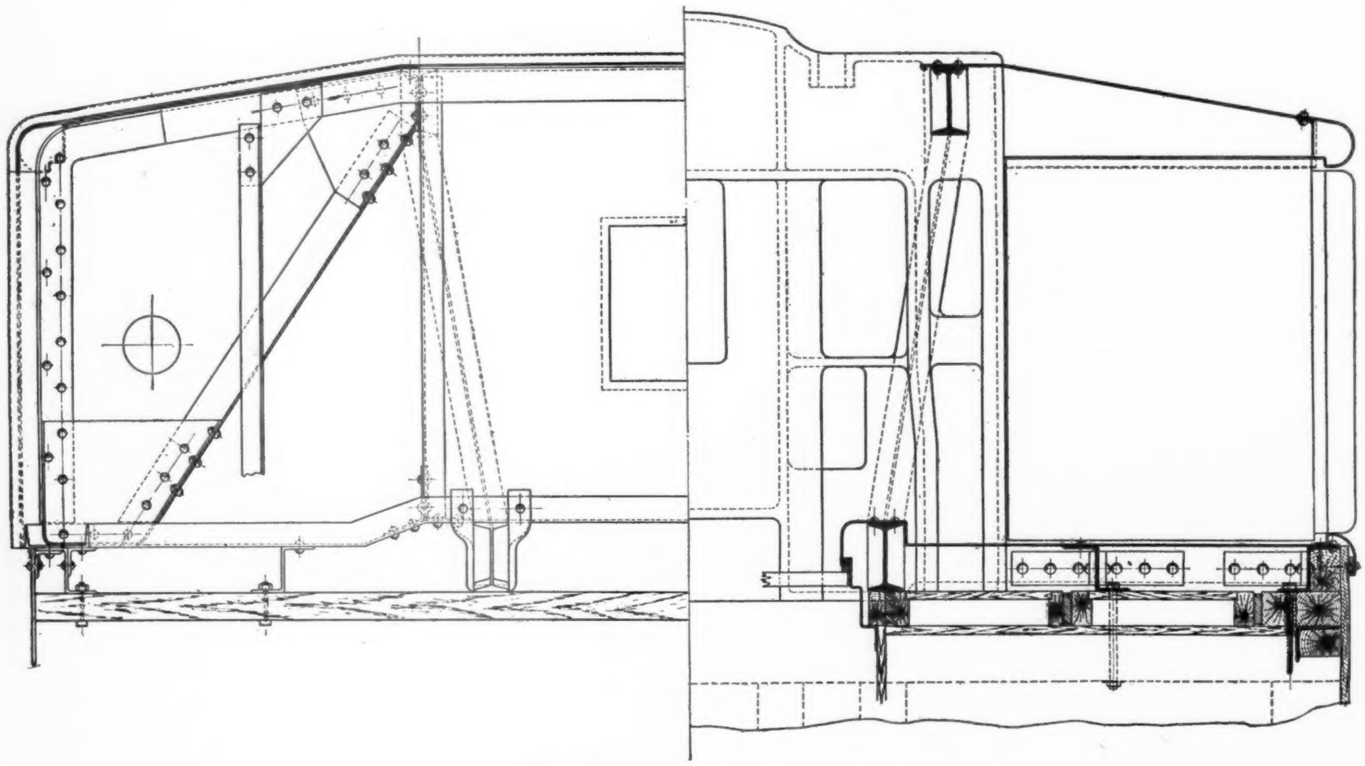
The end sheets are 5/16 in. thick, reinforced at the top by flanges and pressed steel floor connections and connected to the end sills by two pressed steel channels and two angles at each end. The floor sheets are 5/16 in. thick and the side sheets ¼ in. thick, reinforced at the top by 3½ in. x 3½ in. x ⅜ in. angles, at the bottom by 3 in. x 3 in. x ⅜ in. angles, and vertically by eleven stakes on either side of the car made of ¼ in. pressed steel. The sides are tied together by four crossties made of 6 in., 15.7 lb., Z-bars.

NEW END CONSTRUCTION FOR PULLMAN CARS

There has been much discussion during the past few years regarding the best type of end construction for passenger equipment cars and after a study of recent wrecks it has been decided by the Pullman Company that a new arrangement is necessary to withstand the shearing effect that the heavy steel underframing of a car has upon the superstructure of another car when one underframe overrides the other in a collision. The new design adopted is the invention of Richmond Dean, general manager of the Pullman Company. All of the modern Pullman equipment is provided with the Commonwealth steel underframe, which has a cast steel combined platform and double body bolster at each end and this underframe readily permits of the new end construction in combination with which a very efficient arrangement is obtained.

The principal feature of the design is that of an I-beam bent in the form of a U, the legs of which extend upward through apertures in the platform casting. The upper ends of these I-beams are thoroughly anchored in an end superstructure made up of structural shapes. Two of these U-shaped I-beams are applied on each end of the car in the manner shown, one leg forming the door post at the entrance of the car, while the other forms the door post for the opening between the cars at the platform end sills. The U-shaped members are made from one continuous I-beam instead of being made up of riveted sections, in order to eliminate any possibility of riveted joints failing. With this construction it is readily seen that in case of collision, should one underframe override that of the next car, its progress will first be obstructed by the legs of the U-beam at the bumper sill, which as they bend will tend to lift the whole car body, thereby offering greater resistance to further advance of the overriding car. If these should fail there would still be the second leg of the U-shaped member, together with the strengthened car end, to further retard the progress of the overriding underframe.

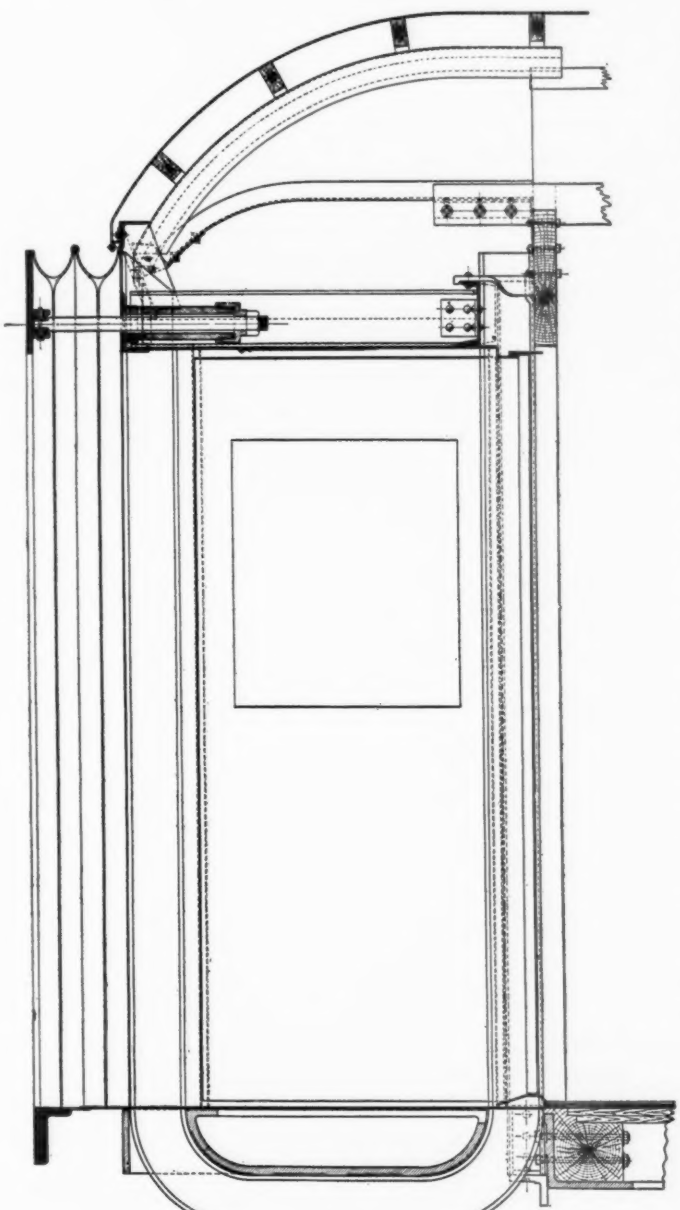
This new car end is being applied to all new Pullman cars and to all high class wooden cars as they pass through the shops for general repairs. Mr. Dean in his patent claims states that unduly strong underframes, instead of affording the presumed advantages of safety to passengers and of preserving the cars from injury, may, at least in some instances, contribute to the damage of the latter, especially when the force of the collision is sufficient to cause the overriding of the underframes, resulting in the breaking down of the end wall of the car. It is his idea to remove the surplus strength from the underframe and so construct and strengthen the vestibule, as described above, that it will act as a cushion to absorb and dissipate the force of the impact of such a collision without materially increasing the



Top and Floor Plans of New End Construction for Pullman Cars.

weight of the car. Throughout the construction it has been his idea to reduce the number of riveted joints to a minimum.

The new car body end wall is securely fastened to the cast steel combined platform and double body bolster, and is made up of Z-bar end posts extending to the top of the roof, and secured to the other parts of the car framing in the usual manner. The outer faces of these posts are riveted to a channel sill above the doorway, which is bent to allow for the rear legs of



Side Elevation of U-Shaped Member in Pullman End Construction.

the heavy U-shaped I-beams; the remainder of the vestibule is constructed to harmonize with the new features. It is believed that this new design will be the means of preventing the disastrous results that have been recently experienced with the ordinary type of end construction in collisions.

REPORTING FOREST FIRES.—The Western Pacific has instructed its engineers to report fires along the right-of-way where it traverses the Plumas national forest in California. The location of fires is indicated on a card dropped by the engineer or fireman to the next section crew met after the fire is discovered. It is then the duty of part of the section crew to go back on handcars or speeders and put out the blaze.

FREIGHT CAR DESIGNING

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So much has been written in connection with freight car design that it would seem that the ideal construction, or a 100 per cent. car for some particular service, had been obtained. Or at all events it would seem that the proper items should have been considered in car construction so that the car would keep off the repair tracks. Perhaps a great deal more will be written before even a small portion of those interested in the design and maintenance of the equipment will be satisfied in their own minds that a perfect car of any class has been built, not to mention the numerous classes which are to be covered. There is also a question as to the best method to produce the best design.

It is believed by some railway officials that the drawings should be made and specifications written by the outside car builders, although it is strenuously objected to by others. It is claimed in the first case, that the builders are better organized in their engineering offices to develop a design to meet the railway company's requirements, and apparently at a less cost, as the cost is included in the price of the lot of cars, and perhaps is not felt by the railroad. In the second case it is held that the users and maintainers of the equipment would better know their own standards, and would be more liable to maintain them in the construction than the builder. And still further, which appeals to the writer as being very important, the railroad, knowing just what facilities are available throughout the system for making repairs, would design the cars accordingly. Maintenance is one of the most important factors in railway operation and anything that will reduce maintenance costs should be considered.

Statements have been made that car builders should design equipment and be responsible for weaknesses which may develop later on, but this is not the customary procedure. In the majority of cases the builder submits the drawings and specifications to the purchaser for checking and approval, which naturally relieves the builder from the responsibility as to the details of the design. It may be said that if the drawing office checks the drawings and specifications, as they are furnished by the builder, all weaknesses will be eliminated, but if the railway does not maintain a sufficient drafting force to draw up the original designs, it will not have the force to thoroughly check the drawings, and further, the time making an accurate check will not be much different from that taken to make the drawings.

If the railroad designs its own freight cars, arrangements should be made whereby all foremen concerned in maintaining the cars could go over drawings and specifications with the designer and understand all parts of the design. This makes the shop men feel a personal responsibility in the cars, and they will watch closely for weaknesses which may develop in service.

In an article which was recently printed in an engineering journal, the author left the impression that if it was desired to design nearly a perfect car it was only necessary to have the practical car men prepare the drawings and specifications. This may, or may not be conceded as the truth, it surely all depends on what is understood by a practical car man. Perhaps some one may say that a practical car man is a person who is a shop man, has repaired cars, has charge of the maintenance of cars, can read a drawing and specification, and understands the construction of a car thoroughly. Again, others will say that a practical car man is a person who has had the experience of repairing cars and maintaining equipment, and can design a car, making all the drawings and specifications, calculating the stresses and strains, and has an understanding as to the strength of the materials entering into the construction. Which is the practical man? The writer will not commit himself as to his belief, but the reader can use his own judgment as to whom he would desire to design equipment for him, were he the man "higher up."

The weaknesses and failures developing every day are not all

due to the designer, whether he be practical or otherwise, as there are many conditions and requirements that must be met over which the engineer has no control. It is often the case that limitations are placed on a design by the requirements of the shippers, the necessity of using certain specialties, the required light weight, or the original cost, which, perhaps, do not allow the designer to follow out in every respect the dictates of his own judgment. The cost of hauling an extra ton of dead weight of car will pay, in some cases, for the repairs that would have been necessary had the car been lighter. However, it must be remembered that a car on the repair track is not in revenue service, and therefore an extra strong car should be given credit for more days in actual service.

It has been the practice of some railways to design the cars, build samples and have them carefully inspected and then put through an accelerated test. In many cases, if time will allow, the car is placed in service for a few days or weeks to ascertain if all the details are properly designed, or, in some cases, the car is loaded considerably in excess of its marked capacity, and the deflections and the permanent set are carefully noted. Although the building of a sample car gives a proper check on the drawings and specifications, it is questionable if any of these tests furnish all the information desired, for the reason that it is not the cars that fail under a static load or under a few days' service which give the trouble, but those that will not withstand the years of rough treatment given to a freight car in service. Again, if the sample car is placed in regular service, it must be realized that perhaps it would never get in such service as to show its weaknesses, while if a great number of the same design were put in use several weaknesses might be developed.

Rapid strides are perhaps being made toward a perfect freight car design, and perhaps it has been reached in some rare instances, but it is hard to be convinced that there are many perfect cars after checking bad order cars on repair tracks for a year, and moreover, if a perfect design has been developed, it is surprising to note that when railroads consider the purchase of new equipment they, as a rule, modify the present designs or develop entirely new ones. This, however, clearly shows that the designers are untiring in their efforts and by a closer observation of the present cars on the repair tracks, ascertaining the weaknesses that have developed in service, there should be marked advances toward better designs. It is feared that in many cases not enough attention is given to the fact that new cars have shown weaknesses, which the designer is slow to acknowledge as weaknesses as they may require some changes or even the abandoning of his entire design. It is not advisable, however, to make changes in the design on the first report of any weakness before a thorough investigation is made as to whether or not the damage was done by fair or unfair usage. In this connection it is advisable to furnish standard forms at all freight car repair points which will furnish all the information desired.

Constant inspection at the repair shops and yards leads one to believe that the increase in strength of the freight cars is not keeping pace with the increase in the severity of the treatment that the cars are receiving in service. Much effort has been made to procure good draft gear, and perhaps an equal amount of thought has been given to its proper application to freight cars. Some steel underframe designs show the draft sill spliced to the center sills between the end sills and the bolster, just back of the draft casting, it being claimed that if the cast draft sills are damaged, they can be replaced without removing the center sills, which is plausible as far as it goes; but others claim, in cases where the center sills extend through to the end sills, acting as draft sills, that if the sills are broken they can then be spliced and thus save the original cost of the splicing of the sills. All who have followed up the repairing of freight cars will appreciate the fact that if the draft gear and the draft sill maintenance could be eliminated the cost would materially be decreased. In making a check of the cars on the repair tracks, taking all cars indiscriminately, it was found that 70 per cent. of the repairs necessary were in relation to the draft rigging, but, as a majority of these were on wooden underframe cars, some improvement along this line is anticipated as steel is substituted for wood.

In the preparation of drawings and specifications for new freight car equipment, the following are some of the parts of the design which should be carefully checked for weaknesses that may develop in service:

On steel underframe or steel cars, the corner back of the push pole pocket should be properly backed up with a casting or a steel gusset. It would seem that the general opinion is that on steel cars the diagonal brace between the bolster and the end sill should extend from the corner of the car to a point near the junction of the draft gear, or center sills, to the bolster. This then becomes a compression member, and of course should have an ample moment of inertia, both in the vertical and horizontal planes. A heavy angle has been used in this place with good success. It is well to carefully figure the shear on the rivets, securing this member at both ends. Some readers will no doubt, bring up an argument in favor of running this diagonal brace from the intersection of the side sill and bolster to the intersection of the end sill and draft sills, but it is the belief of the writer that the draft sill should be of such a design as to withstand the buffing forces without its being necessary to transmit part of the load to the side sill at the bolster by the use of the diagonal braces. Whether the application is made according to the first or second method, it is recommended that a compression member be used, and this has not been done in a great many of the recent designs.

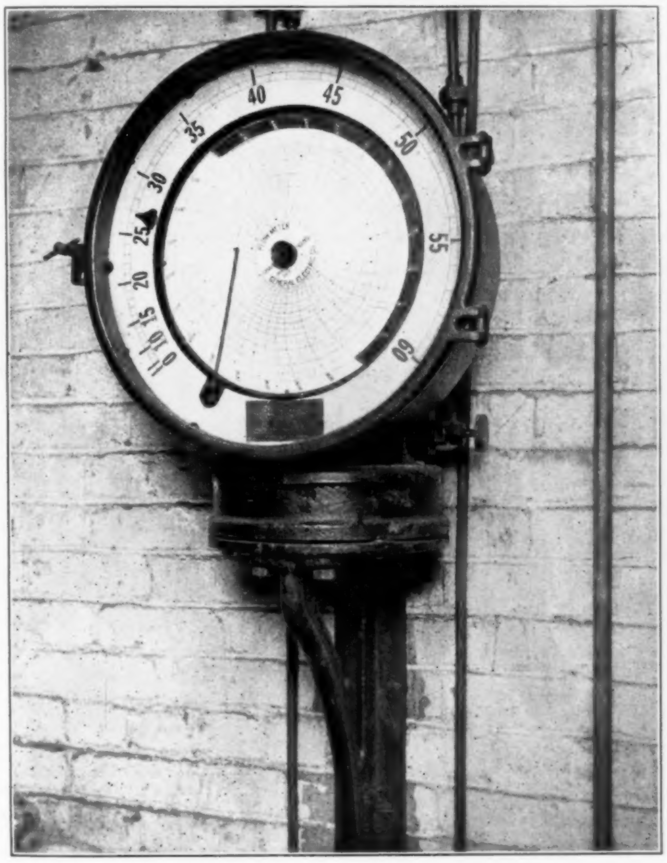
Many types of box car roofs have been designed and applied, and have been given a good service test, but the subject is still a lively one for discussion. Even with the improved designs on the market of both inside or outside metal and all-steel roofs, the mechanical man is still in a quandary as to just which one to recommend for new equipment. They all have their good features. The inside and outside metal roofs have been in use for years, and some data as to original cost and cost of maintenance should by this time easily have been procured, but the type which is known as the all-steel roof has had recent improvements, and it appears that no very marked perfection has as yet been obtained. A roof, of whatever design, must be flexible, and at the same time the metal sheets of which it is constructed must so fit and be so secured to the car that the roof will present a perfectly water-tight construction. It is an interesting fact and a matter of record that the majority of the roofs which require renewing do not have the metal sheets rusted out but are actually worn or broken at the joints or where they are secured to the car, with the exposed part of the sheet in good condition. It, therefore, would seem that the application of the roof to each particular car is an important factor. The flexibility of the roof must be equal to or greater than the flexibility of the car body, and this has been a problem of the roof designers which apparently has not entirely been met.

The tendency at the present time is to increase the amount of steel in freight cars; the box car is getting a steel upper framing, and box cars of all-steel are being built which will probably be given a thorough service test to ascertain if they are entirely feasible. In making a study of the design of cars which have been delivered, or of those which are only contemplated, one is convinced that there is a tendency to get away from a uniformity of design of most all classes of equipment. The use of steel in the construction of cars has brought about many new or novel designs, and some indeed appear directly opposed, yet will no doubt well answer the purpose for which they are designed. It is easy to find cars of the same capacity and class having a one-piece center sill, a two-piece center sill with narrow side sills, or two center sills with a side sill equal in depth to the center sills; all without truss rods—a matter of opinion of the designer, but not tending toward a uniform steel underframe construction.

NEW DEVICES

IMPROVED FLOW METER

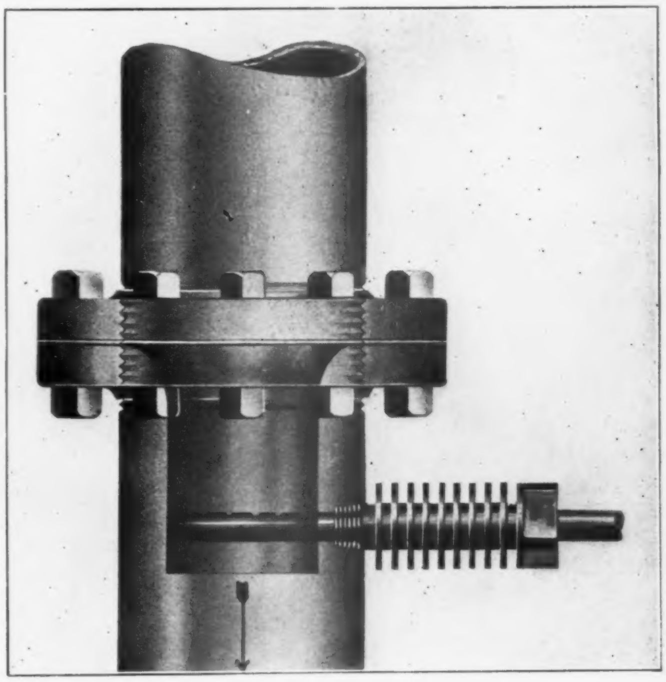
In large power plants, etc., the economical handling of steam, water and air depends on accurate information which will show the total volume transmitted and its instantaneous rate of flow during any interval of time. The meter shown in the illustrations is designed for use either as a test instrument or as a stationary meter. The body consists of an iron casting cored out so as to form one leg of a U-tube and a reservoir for mercury, the outer leg of the U-tube being formed by a pipe which opens into the reservoir. The pressure on the surface of the mercury varies with the rate of flow of the fluid being measured, as will be explained later. A float rests on the surface of the column of mercury in the body of the meter and rises and falls with the corresponding change in its elevation. The



Indicating Recording Flow Meter.

float is geared by a rack and pinion to a horizontal shaft which carries a permanent U-shaped magnet. The poles of this magnet face a copper cap which closes an opening into the meter body and the remaining parts of the meter's mechanism are mounted on the outside of the cap. A shaft, parallel to the one on which the magnet inside the body is mounted, carries a smaller magnet, whose poles are opposite to those of the larger magnet, this arrangement serving to transmit motion through the cap without piercing it with a shaft. As the poles facing one another are of opposite polarity, the magnetic flux binds them together so that a movement of the magnet inside the body involves a corresponding movement of the one outside, the latter moving the indicating needle and the recording pen through suitable mechanism.

The pressure which moves the column of mercury in the U-tube is obtained, for pipes 2 in. and greater in diameter, by inserting a modified form of Pitot tube, termed a "nozzle plug," directly into the pipe line. This can be done without disturbing the piping, except where it is desired to increase the rate of flow at the point of metering, in which case a special pipe reducer is provided. This reducer is made of brass and has a long throat with rounded entrance terminating in a flange which is inserted between the pipe flanges and is held in place in the same manner as a gasket. A special nozzle plug is supplied with the pipe reducer. The nozzle plug is a tube with two separate conduits in it, each conduit having a set of openings, the two sets being on diametrically opposite sides of the tube. Those on the side of the tube facing the flow are called the leading openings, and those on the opposite side the trailing openings. The flow against the leading openings in the nozzle plug sets up a pressure in the leading conduit which equals the static pressure plus a pressure due to the velocity head; the



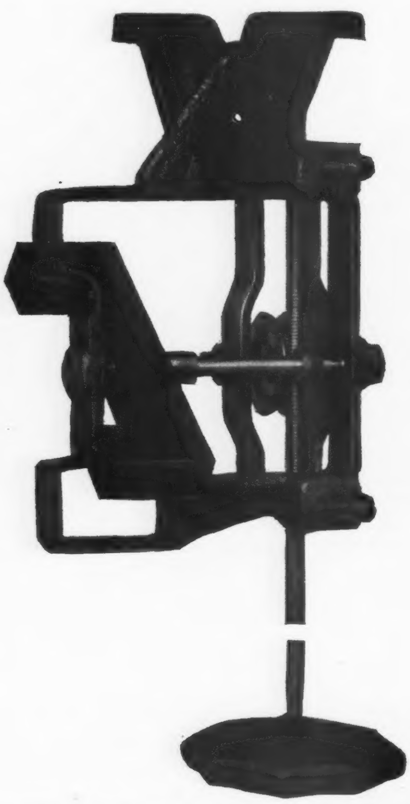
Pipe Reducer and Nozzle Plug.

flow past the trailing openings causes a suction which lowers the pressure in the trailing conduit. As these two conduits are connected to the U-tube by ¼-in. pipes, the column of mercury is affected by this unbalanced pressure, causing a movement of the float. The leading set of openings in the nozzle plug extends approximately across the pipe, so as to make the velocity pressure transmitted to the meter the mean, rather than that at a single point in the pipe.

The chart on which the pen records are made is rotated by a clock work at a suitable speed. The recording pen sweeps the chart radially, and the resulting curve shows the rate of flow at any time during the chart cycle. The integrating device consists of a stationary flow-rate planimeter driven by the chart paper. The angular position of the planimeter wheel is determined by a cam connected to the shaft of the recording pen and moving with this pen. The planimeter dials read in arbitrary units, which, multiplied by a constant furnished with the

meter, gives the flow in the desired unit. This device is extremely simple and there is practically no danger of its getting out of adjustment.

For pipes less than 2 in. in diameter, an orifice tube, which is a brass pipe tapered internally from both ends and so as to form a restricted opening at the middle of the tube, is provided and must be incorporated in the pipe line. One leg of the U-tube is connected to the orifice tube near its end and the other leg to its middle point where the greater velocity at the orifice will give a reduced pressure in the pipe leading to the U-tube.



Float and One of the Magnets of the Flow Meter.

To meet the requirements of different classes of service and the various conditions met with, this meter is made in four different ways—as a recording or curve-drawing instrument; with both indicating scale and recording chart; with recording chart and integrating dials; and with indicating scale, recording chart, and integrating dials. It is manufactured by the General Electric Company, Schenectady, N. Y.

OSMAN BOILER CHECK

In an article in the August issue of the *Railway Age Gazette, Mechanical Edition,* describing the Osman regrinding and pressure equalizing boiler check, it was stated that this device is manufactured by the Swenson Valve Company, Decorah, Iowa. This is incorrect, as the rights for the manufacture and sale of the valve are controlled by G. H. Osman, who is superintendent for that company.

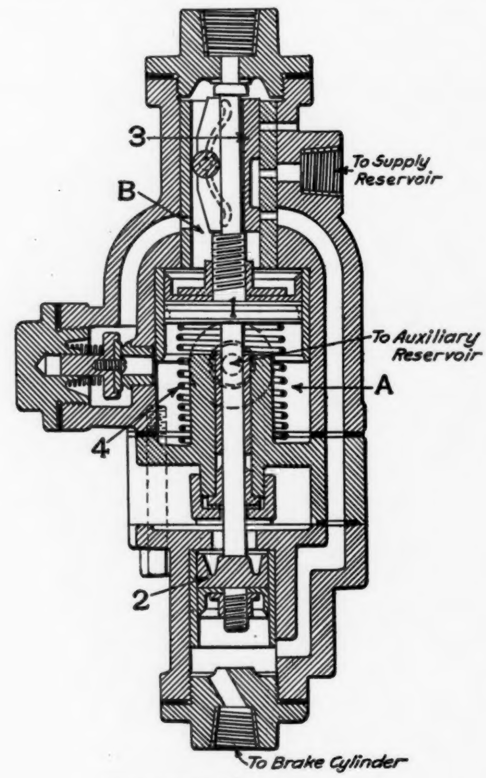
Aerial Railway in Colombia.—By permission of the Colombian government, Thomas Miller, who held a concession from the government for constructing an aerial railway between Manizales, Pereira, or Neira, and the National Occidental Railway, has transferred his concession to the Dorada Railway, Ltd., of London. Six months' extension of time for putting the railway into service has also been granted.

UNITED STATES AIR BRAKE

The United States Air Brake Corporation, Buffalo, N. Y., has developed a system of locomotive and car air brake equipment which is now being tried out on three railroads, among which is the Buffalo, Rochester & Pittsburgh.

The principal feature of the locomotive equipment is the quick release, which provides three exhaust ports to insure the rapid escape of the air from the brake cylinders to the atmosphere. This feature does not interfere with the normal automatic release, as, when it is desired, one exhaust port may be used. Provision is also made for retarding the release when necessary, and the locomotive brakes can be graduated on or off independently from the train brakes whenever desired.

In addition to the triple valve, there is used in the car equipment what is termed a regulating maintaining valve, whose purpose is to prevent excessive piston travel and brake cylinder leakage. This valve is furnished with a supply reservoir, and it is claimed that it will automatically increase the brake cylinder pressure in correct proportion to the brake pipe reduction, regardless of the piston travel, and that it will maintain that pressure during a brake application, regardless of ordinary cylinder leakage.



Regulating Maintaining Valve.

When the car equipment is being charged, air from the auxiliary reservoir enters chamber *A* of the regulating valve and passes the check valve, filling chambers *A* and *B*. When a brake pipe reduction is made the triple valve permits auxiliary reservoir pressure to flow into the brake cylinder, lowering the pressure in chamber *A*. Should the charge of air from the auxiliary reservoir be sufficient to exert a force on the underside of the small piston *2*, which combined with the force on the underside of the large piston *1* would equal the force on top of the latter, there would then be no movement of the parts in the regulating valve. However, should the piston travel be excessive and the force on the underside of the small piston not sufficient in combination with the pressure in chamber *A* to equalize with the pressure in chamber *B*, the large piston would then move down and bring the slide valve *3* in position to admit air from the

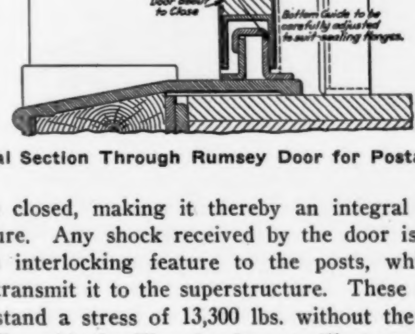
supply reservoir to the brake cylinder; when the cylinder pressure is increased so that the force on the underside of the piston *2* is sufficient in combination with the pressure in chamber *A* to equal the force in chamber *B*, the equalizing spring *4* will push the large piston and slide valve back, shutting off the supply reservoir from the brake cylinder. After the pressure in the brake cylinder has been increased to the proper amount, if there should be any leakage from the brake cylinder the piston *2* would again be forced down by the pressure in chamber *B* and again permit pressure from the supply reservoir to flow into the brake cylinder until the combined force on the undersides of the small and large pistons equalled the force on the top of the large piston; the equalizing spring would then again force the piston and slide valve up and close the port which admits air from the supply reservoir to the brake cylinder.

When the brake is released by increasing the brake pipe pressure and forcing the triple valve to release position, the sudden drop of brake cylinder pressure will cause the large piston to make a quick downward movement, carrying the slide valve down until its extreme end passes the small vent port, which allows the pressure in chamber *B* to equalize with that in chamber *A*; the equalizing spring will then force the large piston and the slide valve back to normal position. It is not necessary that the pressure in chamber *B* should be permitted to escape when the brakes are released, as the raising of the auxiliary reservoir pressure in combination with the force of the equalizing spring, will hold the large piston in its normal position.

RUMSEY MAIL CAR DOOR

The illustrations of the door sections show clearly how the features involved in the standard freight car door manufactured by the Rumsey Car Door & Equipment Company, Chicago, have been included in the mail car door recently developed by that company. When closed, the door is forced to a positive bearing on all four sides by the door post sealing flanges, which not only make it watertight but keep the cold out in winter.

The chief point of interest in the Rumsey car door is the pressed steel, unitary post structure which is anchored at the top and bottom to the car sills and into which the door inter-

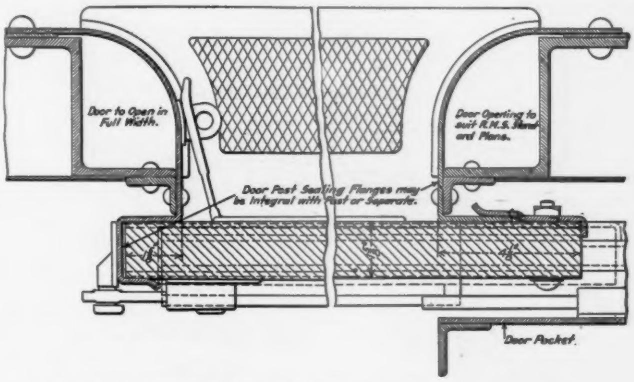


Vertical Section Through Rumsey Door for Postal Cars.

locks when closed, making it thereby an integral part of the superstructure. Any shock received by the door is transmitted through its interlocking feature to the posts, which by their anchorage transmit it to the superstructure. These pressed steel posts will stand a stress of 13,300 lbs. without the wood fillers and 15,000 lbs. with the fillers in place; to illustrate further, they take a stress equal to the resistance of a stick of oak 42¾ in. x 4¾ in. This represents the stress received at the center of the post, when No. 10 gage open hearth steel is used.

The combined steel and wood post is similar to what is known as the Harriman standard. The steel member extends sufficiently beyond the face of the post to form interlocking sealing flanges whose functions are identical with those of the all-steel post, and this construction is recommended for rebuilt equipment and for stock cars, owing to its moderate cost.

This company has also designed a flush door which does not



Horizontal Section Through Rumsey Postal Car Door.

interfere with the strength of the car superstructure and is the type recommended for stock and refrigerator cars. This particular type of door is also applicable to box cars.

BOYER PNEUMATIC SAW

A recent innovation in car building is the cutting and trimming of the car roofs with a Boyer pneumatic saw. A No. 2 Boyer air drill furnishes the power, and by a special arrangement of gearing, the speed of the spindle in which the saw arbor is fitted is brought up to 2,200 revolutions a minute. The

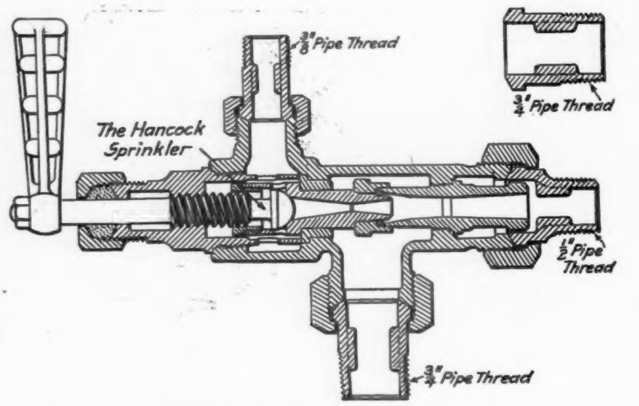
Boyer Pneumatic Saw Triming a Car Roof.

motor itself rests on a grooved shoe which fits over a guide strip nailed to the car roof at the proper distance from the edge. The arbor, bearing an 8 in. circular saw, is also supported by a shoe. It will cut a 60 ft. car roof in 1½ min. It is manufactured by the Chicago Pneumatic Tool Company, Fisher building, Chicago.

ERIE AND MAD RIVER RAILROAD.—A body of the United States Corps of Engineers are engaged in making a survey of the route from Sandusky city to Dayton, Ohio.—*From the American Railroad Journal, October 27, 1832.*

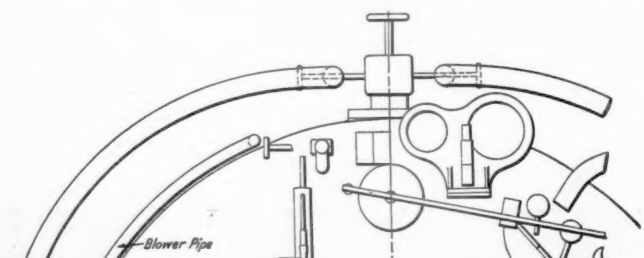
IMPROVED COAL SPRINKLER

Among the devices recently placed on the market for the use of locomotive firemen in sprinkling coal is the ejector which was developed by the Hancock Inspirator Company, Boston, Mass., and was described in the *Railway Age Gazette,* Mechanical Ed-



Improved Hancock Coal Sprinkler.

ition, June, 1913, page 334. Investigation of the subject of coal sprinklers has convinced the manufacturers that, as a safeguard, the apparatus should be operated entirely by one handle, so arranged that the water connection will positively be closed when



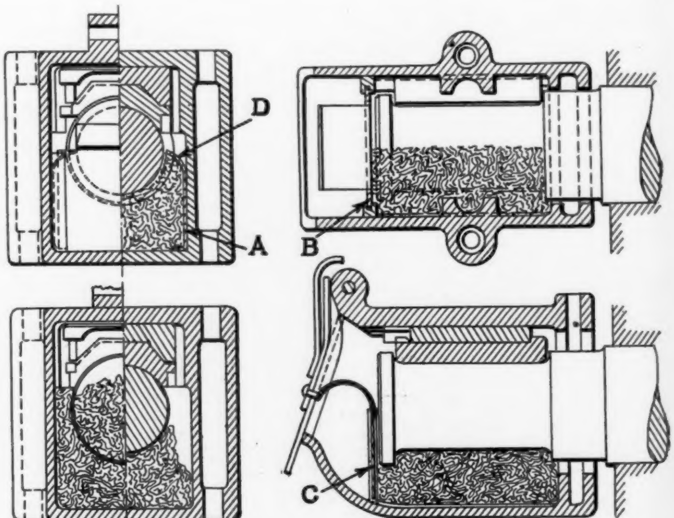
Coal Sprinkler in Position on Backhead of Boiler.

the sprinkler is not in operation. Unless the water passage is entirely closed when the injector is used for heating the water in the tank, steam is likely to back up through the suction pipe of the sprinkler and result in injury. With sprinkling devices having separate valves for the steam and water connections, there is always the possibility that the man operating the device will forget to open the water valve in the suction when starting the sprinkler, or forget to close it when shutting off the sprinkler. In an improved coal sprinkler which has been devised by the Hancock Inspirator Company, only one handle is used, and this operates both the steam and water valves. As shown in the drawing of the cross section, the sliding steam nozzle is so constructed that its front end overlaps the back end of the combining tube when the steam valve is closed, thus effectually closing the water opening; when the steam valve is open the steam nozzle which is attached to it is drawn back from the combining tube at the same time that the steam port is opened. The sprinkler, as shown in the other illustration, is located on the left hand side of the cab and takes its water supply from the suction pipe of the injector through a ¾ in. pipe. A ⅜ in. globe valve is placed in the steam supply pipe to shut off the steam from the sprinkler when necessary.

WASTE RETAINER FOR JOURNAL BOXES

The object of the attachment illustrated herewith is to keep the waste in a journal box from working forward and forcing open the lid, and to prevent it from piling up in front of the journal collar and away from the inner end of the journal. The device also prevents the waste from getting under the journal brass. As the waste is held close to the journal under the brass, the journal is kept lubricated at all times without becoming heated; furthermore, the device prevents cinders and dust from getting into the packing.

The side waste retaining members, *A,* are formed with curved extensions which serve to support them at the inner end. The front edge of each side member is provided with a lug, *B,* in which is a slot adapted to receive the closing gate, *C.* The



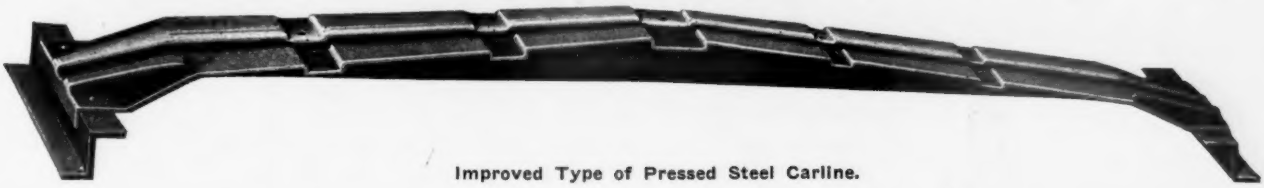
Device for Holding Waste in Journal Boxes.

upper edges of the side members are curved inward as shown at *D,* so as to come against the journal and serve as a stop to prevent waste from being dragged upward under the brass. The device is made of 1/16 in. sheet steel and can be applied by removing all the packing from the box and taking both side plates, which are wired together at the bottom at the back end, in both hands and sliding them into place. The brass and wedge can be removed without disturbing the retainer, and inspectors are also given a better opportunity to inspect the brass and journal on account of the packing being held down. It is also claimed that the packing necessary is reduced 50 per cent.

This device has been applied with great success to 750 50-ton freight cars, 5 coaches and the tenders of 30 heavy consolidation locomotives on the Pittsburgh, Shawmut & Northern. It was invented and patented by R. A. Billingham.

PRESSED STEEL CARLINE

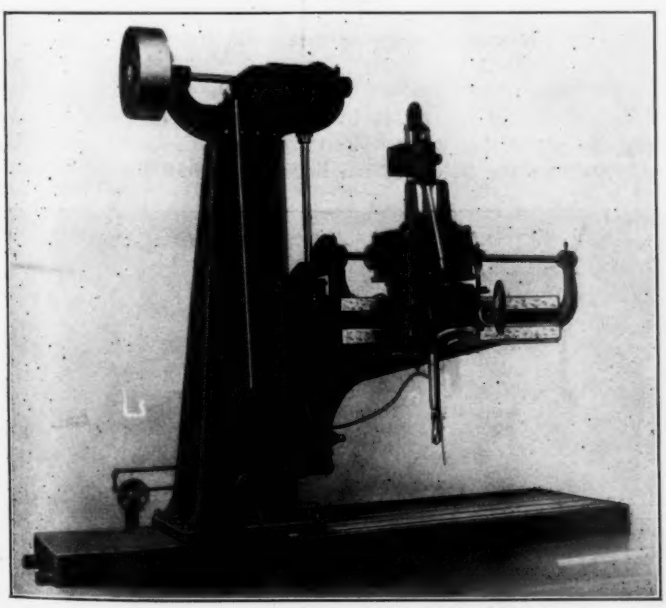
A new style of pressed steel carline has recently been designed by the Cleveland Car Specialty Company, Cleveland, Ohio, in connection with the use of steel side plates in car framing. It is necessary that the carline should rest flat on the side plate with large bearing surface and the design illustrated is now being placed on a large number of cars with steel side plates. While it is intended for steel framing, it is equally applicable to cars with wood side plates. In a recent test, it required a pressure of over 4,500 lbs. to deflect it when placed upon supports spaced the same interval apart as the side plates. The use of pressed steel for carlines has made it possible to produce a design in which the maximum strength is gained with a minimum weight, as the whole carline can be made from one piece of steel and the metal distributed where it is most needed.



Improved Type of Pressed Steel Carline.

HIGH DUTY RADIAL DRILL

In response to a demand for a radial drill which would be at once easy to operate and rigid and powerful enough to do the heaviest class of work, the Baush Machine Tool Company, Springfield, Mass., has brought out a 6 ft. machine having the bed, arm and column, as well as the head mechanism, extremely heavy and rigid.

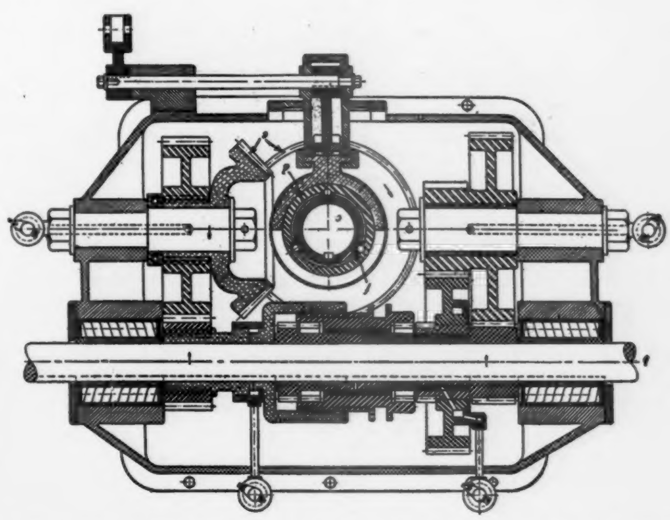


Heavy Service Six-Foot Radial Drill.

The post is of rectangular box form, and is tapered to provide an ample base. The saddle carrying the earm trunnions is extra long and rigid, and is elevated with a screw. The arm itself is mounted on large trunnions which are provided with ball thrust bearings to take the weight, and roller bearings to provide for easy operation.

The head gearing is all enclosed in an oil-tight case, and the main drive consists of the conventional vertical shaft down to the center of the trunnion, and a horizontal driving shaft, *b*, extending through the head to an outboard bearing on the arm. Both of these shafts are provided with ball thrust bearings, and in the case of the two horizontal shafts, the one on the head of the machine and the one extending the length of the arm, roller bearings are added.

The gearing of the head proper is entirely enclosed, the feed being accomplished by means of worm and worm gearing and a pinion engaging in a rack, which is mounted on a quill on the upper end of the spindle. This quill is provided with ball bearings to take care of the thrust in either direction. The spindle proper, *c*, extends down through the head and is driven by means of a long sleeve, *d*, which in turn drives the feed mechanism from the lower end. The drive is accomplished by means of a pair of bevel gears, *e*, which are arranged to be clutched to the spindle, providing in this way a tapping attachment and at the same time a stop motion for the spindle when the clutch is in the intermediate position. The method of keying this clutch spindle to the driving sleeve is unusual in that it is accomplished by means of three lines of balls, *f*, mounted in ball cases and traveling in hardened steel races, providing a clutch spline which moves practically without friction; it is therefore possible to start, stop or reverse the spindle with a minimum of effort on the part of the operator.

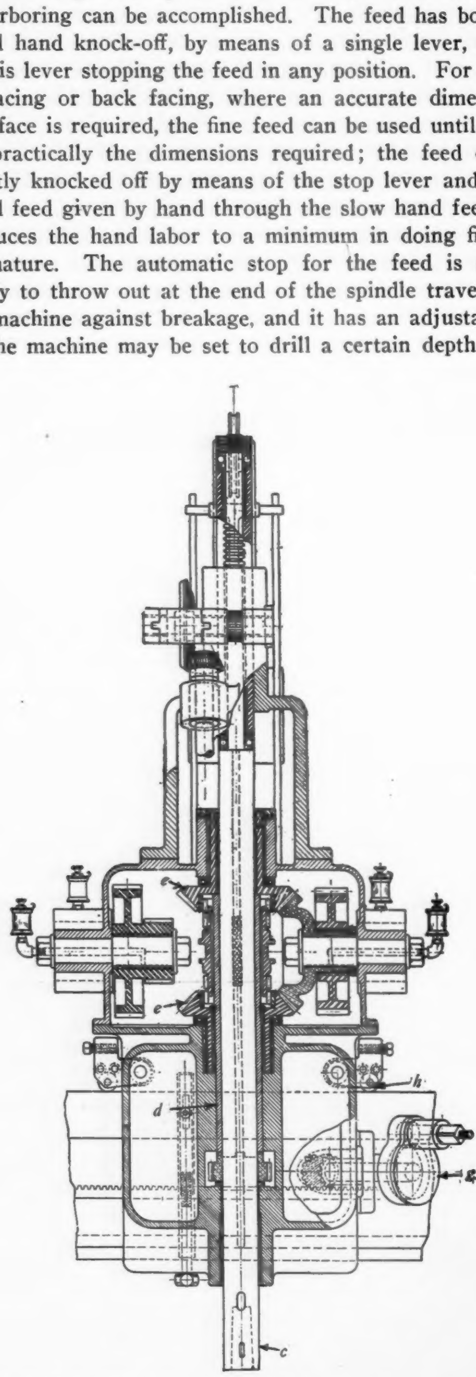


Horizontal Section Through Head of the New Baush Radial Drill.

The back gears are carried in two nests, one on each side of the spindle and in enclosed oil tight case, thus providing a balanced head. The back gear is thrown by means of a lever on the front of the machine and is arranged to lock in either high or low position. The gearing and all bearings are oiled from the outside by means of sight feed cups. The bevel gears are all provided with ball thrusts and the bearings are bronze bushed. The gears themselves are alternately steel and bronze.

The machine is provided with six changes of feed by means of a sliding key, and also by a quick and slow hand feed; the

quick feed is provided for by a large hand wheel directly on the feed shaft, while the slow feed is obtained by a small hand wheel which is geared up to such an extent that back facing or counterboring can be accomplished. The feed has both automatic and hand knock-off, by means of a single lever, one motion of this lever stopping the feed in any position. For counterboring, facing or back facing, where an accurate dimension or a flat surface is required, the fine feed can be used until the tool reaches practically the dimensions required; the feed can then be instantly knocked off by means of the stop lever and a slight additional feed given by hand through the slow hand feed wheel. This reduces the hand labor to a minimum in doing fine work of this nature. The automatic stop for the feed is arranged principally to throw out at the end of the spindle travel to protect the machine against breakage, and it has an adjustable stop, so that the machine may be set to drill a certain depth.



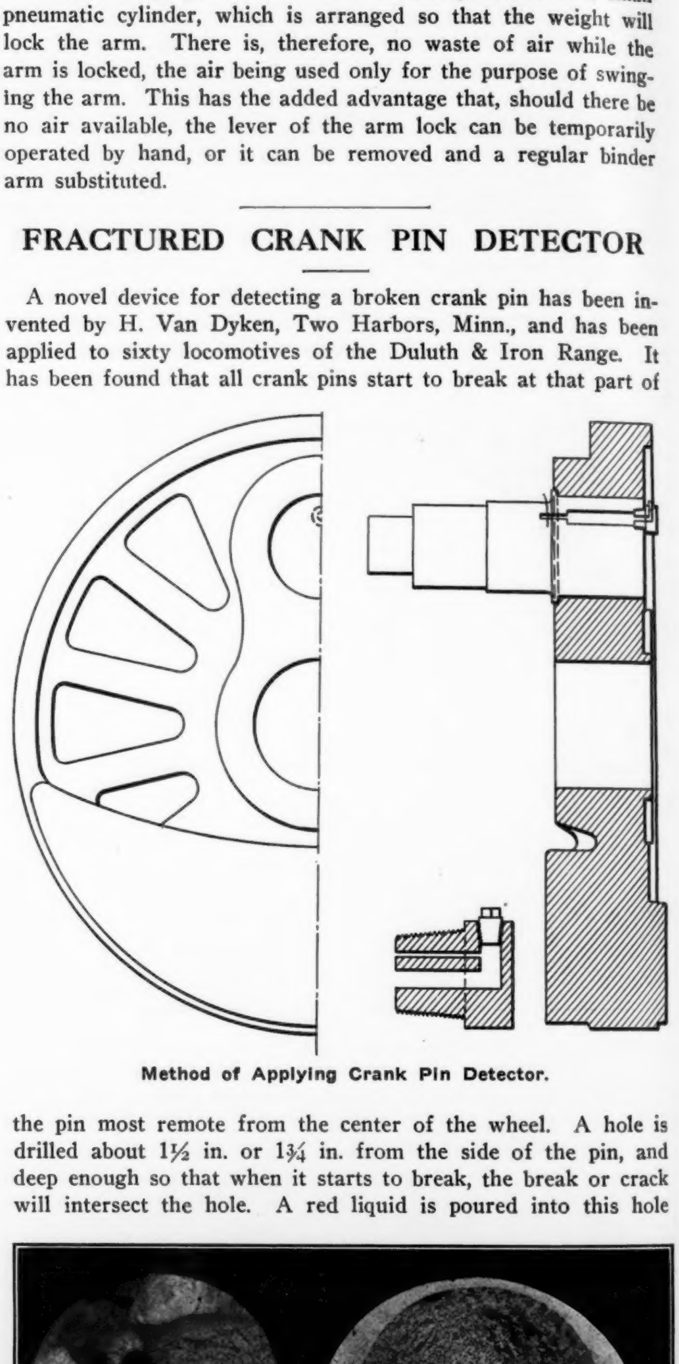
Vertical Section Through Head of Baush Radial Drill.

The traverse of the head on the arm is accomplished by means of a hand wheel and the spiral gearing *g*, operating in a rack in the conventional way, except that the hand wheel is geared up so that the traverse is accomplished with a minimum amount of effort on the part of the operator. The head is carried on a pair of friction rollers, *h*, which are set up by very powerful springs. The binder for the head is arranged to clamp it against the bottom surface of the arm, that is, in the direction that the work forces it. The spindle is accurately counterweighted and is driven by its largest diameter. Owing to the driving sleeve, the action of the feed does not in any way tend to draw the tapping clutch in or out of engagement.

The arm is raised and lowered by means of a screw and is arranged with a binder to lock it on the post. The arm is prevented from swinging by means of the conventional arm lock, the latter being operated from the saddle by means of a small pneumatic cylinder, which is arranged so that the weight will lock the arm. There is, therefore, no waste of air while the arm is locked, the air being used only for the purpose of swinging the arm. This has the added advantage that, should there be no air available, the lever of the arm lock can be temporarily operated by hand, or it can be removed and a regular binder arm substituted.

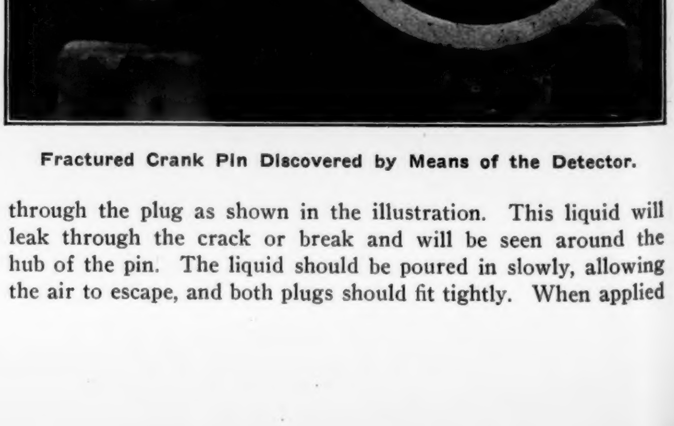
FRACTURED CRANK PIN DETECTOR

A novel device for detecting a broken crank pin has been invented by H. Van Dyken, Two Harbors, Minn., and has been applied to sixty locomotives of the Duluth & Iron Range. It has been found that all crank pins start to break at that part of



Method of Applying Crank Pin Detector.

the pin most remote from the center of the wheel. A hole is drilled about 1½ in. or 1¾ in. from the side of the pin, and deep enough so that when it starts to break, the break or crack will intersect the hole. A red liquid is poured into this hole



Fractured Crank Pin Discovered by Means of the Detector.

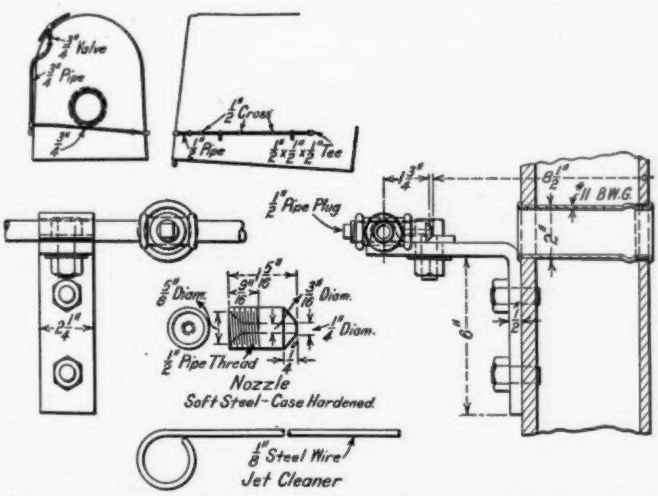
through the plug as shown in the illustration. This liquid will leak through the crack or break and will be seen around the hub of the pin. The liquid should be poured in slowly, allowing the air to escape, and both plugs should fit tightly. When applied

to old crank pins they should be examined after the first trip for it may have been defective for some time. Crank pins should be examined twice a month by unscrewing the little filling plug. Should the liquid remain in the pin for a long time, and finally the pin be found dry, and the substance could not be seen around the hub on the outside, the hole should be refilled. This detector not only avoids the trouble of broken crank pins on the road but it also saves the expense of taking out crank pins that are in good condition, for fear they might break soon.

The crank pin shown in the photograph was detected twice by this method. When the pin had cracked to the first or small hole, it was considered safe to use the engine for a while and a second hole was drilled further toward the center of the pin. The distance between centers of the two holes is 1⅞ in. The engine remained 21 days in continuous heavy service, before the liquid leaked out of the second hole. The pin was then pressed out and replaced.

SMOKE BURNING DEVICE

The Chicago & North Western is equipping all of its locomotives entering Chicago with the steam jet smoke consumer shown in the accompanying illustration. The arrangement is in accordance with the recommendations made by a sub-committee of the General Managers' Association of Chicago, appointed to investigate the value of the steam jets in locomotive fireboxes.*



Details and Arrangement of Firebox Steam Jets; Chicago & North Western.

This device has been found very effective when used in conjunction with the quick action blower valve described in the March, 1913, issue of the *American Engineer*, page 160. The results following the use of this arrangement were also published in this journal on page 236 of the May, 1913, issue.

UNPRECEDENTED SPEED.—The new steamboat *Patrick Henry*, built in Baltimore to run between Norfolk and Richmond, is now in the line and performed the distance, 145 miles, on Tuesday last in 7 hours and 43 minutes, after the stoppages were deducted.—*From the American Railroad Journal, September* 8, 1832.

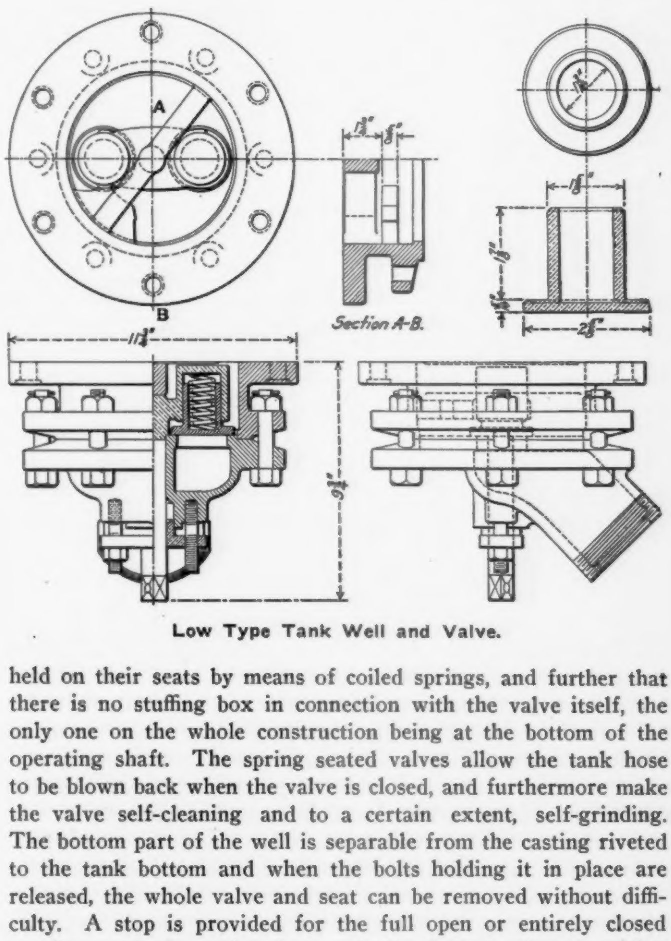
RAILROAD CARS.—A gentleman from Rockland county called upon us a few days since with a model of a railroad car. His improvement consists, he says, in the manner of placing the car upon the axis of the wheels. The model may for the present be seen at this office by those who feel interested in such matters.—*From the American Railroad Journal, September* 15, 1832.

*A report of the tests made by this committee was presented before the Master Mechanics' Association last June and abstracted in the *Daily Railway Age Gazette* of June 14, page 1377.

TANK WELL AND VALVE

A low type of tank well has been designed in the mechanical engineer's office of the Delaware, Lackawanna & Western, and is being applied to all of the new locomotives built for that road. As can be seen in the illustration, it is characterized by simplicity, lightness and ease of application and operation. It consists of a hollow well which contains a pair of sliding disc valves held in a rotating frame which is operated by a shaft projecting through the bottom of the well. The arrangement is such that all the upper rigging of the ordinary type of tank well and valve is entirely eliminated.

It will be seen in the illustration that the two valve discs are



Low Type Tank Well and Valve.

held on their seats by means of coiled springs, and further that there is no stuffing box in connection with the valve itself, the only one on the whole construction being at the bottom of the operating shaft. The spring seated valves allow the tank hose to be blown back when the valve is closed, and furthermore make the valve self-cleaning and to a certain extent, self-grinding. The bottom part of the well is separable from the casting riveted to the tank bottom and when the bolts holding it in place are released, the whole valve and seat can be removed without difficulty. A stop is provided for the full open or entirely closed position, and the valve is practically locked when in either position.

SAFETY TALKS IN PAY ENVELOPES.—One of the latest ideas in what has sometimes been called welfare work is a plan of insurance now being tried out by the Kilbourne & Jacobs Manufacturing Company, Columbus, Ohio. The scheme is that all of the employees are properly protected against accidents during the full twenty-four hours of each day. This is accomplished by insuring them under a blanket policy of an accident insurance company for one-half of the workman's weekly wage. When a man punches the time clock in the morning he knows that he is insured for the ensuing twenty-four hours. The company pays the premiums and collects and disburses to the injured employee all indemnities due. No charge is made the workman for the cost of the premium, nor is he asked to sign any release papers for an injury sustained in the factory or outside. If the workman's injury keeps him incapacitated for fifty-two weeks, one-half his weekly earnings is paid to him for that period, with the exception of the first week's payment, for which there is no indemnity allowed.—*Michigan Manufacturer and Financial Record.*

NEWS DEPARTMENT

According to a press despatch the Chicago & North Western is now operating all its trains out of Omaha, Neb., by oil burning locomotives.

The Western Maryland has arranged with a correspondence school to instruct its enginemen in the use of the air brake and an instruction car will soon be put in service.

A Rock Island train was delayed for 40 minutes on July 30 near Ford, Kan., by a large number of grasshoppers that had blown on the track at a deep cut. The trainmen were obliged to scoop them off the tracks with shovels and sand the rails before the train could proceed.

The committee of management of the International Engineering Congress (1915), has announced that Col. Geo. W. Goethals, chairman of the Isthmian Canal Commission and chief engineer of the Panama Canal, has consented to accept the honorary presidency of the Congress and will preside in person over the general sessions to be held in San Francisco, September 20-25, 1915.

R. C. Richards, chairman of the Central Safety Commiteee of the Chicago & North Western, is furnishing to all the moving picture shows along the line of the road a set of stereopticon views similar to those shown in its trespass circular, showing the manner in which so many people are killed and injured while trespassing on railroad tracks. One of the slides used shows a statement giving the number of persons killed and injured while trespassing in the last 20 years.

AUTOMATIC STOPS ON THE NEW HAVEN

The New York, New Haven & Hartford announces that its offer of $10,000 for the best automatic stop has expired; and that 2,816 persons have entered the competition. Only 704 of the applicants have submitted plans; but any inventor who got his name on the list before July 1 will be allowed until January 1, 1916, to qualify. C. H. Morrison, signal engineer of the road up to July 1 had written 4,062 letters; and 1,483 copies of patents had been obtained from the Patent Office. Of the 704 devices of which plans have been submitted not one has met condition No. 1, which reads: "The apparatus should be so constructed that the removal or failure of any essential part would cause the display of a stop signal and the application of the train brakes, and if electric circuits are employed, they should be so designed that the occurrence of a break, cross, or ground, or a failure of the source of energy in any of the circuits, should cause the display of a stop signal and the application of the train brakes." A few of the devices submitted might be made to meet this requirement. The company will proceed at once to test two devices on the western division, between Hartford and Newington. One of these is the invention of Mr. Webb, of the International Signal Company, and the other of an engineer of the Union Switch & Signal Company.

A SAFETY EXPOSITION IN DECEMBER

The first international exposition of Safety and Sanitation ever held in America will be held in New York City, December 11 to 20, 1913, under the auspices of The American Museum of Safety, 29 West Thirty-ninth street. Safety and health in every branch of industrial life, manufacturing trade, transportation, business and engineering, in all of their sub-divisions will be represented at this exposition. By a special act of Congress, exhibits from foreign countries are to be admitted free of duty. European employers have cut their accident and death rate in half by a persistent campaign for safety. There are 21 museums of safety in Europe. All of these will contribute to the exposition.

AMERICAN LOCOMOTIVE COMPANY

The annual report of the American Locomotive Company for the year ended June 30, 1913, shows that the earnings of that company increased in proportion to the very large increase in locomotive construction during that period compared with the previous year. In the calendar year 1912 the number of locomotives ordered was larger than in any other year since 1906 and until June, 1913, orders continued to come in at approximately the same rate. The gross revenue for the year, $54,868,175 including earnings from the manufacture of automobiles, was the largest of any year in the history of the company. It was $24,418,723 larger than in 1912; $5,350,000 larger than in 1907, the best previous year, and over twice as great as in 1902, the first year in the company's history. The amount earned on the common stock was 17.7 per cent. compared to 0.47 per cent. in 1912 and 18 per cent. in 1907. No dividends have been paid on the common stock since 1907. The company started the year under the most auspicious conditions, for on June 30, 1912, the contract work in course of construction amounted to $2,051,187, compared with $740,550 one year before; also the amount of unfilled orders on July 1, 1912, was $14,450,000, compared with $6,015,000 on the corresponding date of the previous year. Judging from present indications the earnings of the fiscal year 1914 will show a decrease from those of last year, for, although the contract work in course of construction on June 30, 1913, amounted to $3,975,022, and the amount of unfilled orders on the following day was $17,156,388, orders have shown a sharp falling off since last May, so much so that it is expected that there will be a reduction in the operations of the plants in theUnited States in the near future.

MEETINGS AND CONVENTIONS

The following list gives names of secretaries, dates of next or regular meetings, and places of meeting of mechanical associations.

AIR BRAKE ASSOCIATION.—F. M. Nellis, 53 State St., Boston, Mass.

AMERICAN RAILWAY MASTER MECHANICS' ASSOC.—J. W. Taylor, Old Colony building, Chicago.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—A. R. Davis, Central of Georgia, Macon, Ga.

AMERICAN SOCIETY FOR TESTING MATERIALS.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Annual meeting, December 3-6, Engineering Societies' Building, New York. Railroad session, Thursday morning, December 5.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 841 North Fiftieth Court, Chicago; 2d Monday in month, Chicago.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—C. G. Hall, 922 McCormick building, Chicago. Convention, May 18-22, 1914, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 829 W. Broadway, Winona, Minn.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—A. L. Woodworth, Lima, Ohio.

MASTER BOILER MAKERS' ASSOCIATION.—Harry D. Vought, 95 Liberty St., New York.

MASTER CAR BUILDERS' ASSOCIATION.—J. W. Taylor, Old Colony building, Chicago.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOC. OF U. S. AND CANADA.—A. P. Dane, B. & M., Reading, Mass. Convention, Sept. 9-12, 1913, Ottawa, Can.

RAILWAY STOREKEEPERS' ASSOCIATION.—J. P. Murphy, Box C, Collinwood, Ohio.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. & H. R., East Buffalo, N. Y.

Personals

It is our desire to make these columns cover as completely as possible all the changes that take place in the mechanical departments of the railways of this country, and we shall greatly appreciate any assistance that our readers may give us in helping to bring this about.

GENERAL

G. M. Crownover, master mechanic of the Chicago Great Western at Oelwein, Iowa, has been appointed superintendent of motive power, with office at Oelwein, succeeding J. G. Neuffer, resigned to retire from railway service.

J. E. McQuillen has been appointed mechanical superintendent of the Gulf, Colorado & Santa Fe, with headquarters at Cleburne, Tex., succeeding P. T. Dunlop. He was born at Rochester, N. Y., January 25, 1873, and was educated in the public schools of Rochester and at the Sacred Heart Academy at Palestine, Tex. He began railway work in October, 1887, as roundhouse caller for the International & Great Northern at Palestine, being employed in that capacity until February, 1888, from which time until April, 1892, he was a machinist apprentice. He was then until October, 1895, machinist and foreman in various railroad and contract shops in the United States and Mexico, on the latter date being appointed general foreman of the Houston East & West Texas at Houston, Tex. From January, 1897, to June, 1901, he was a machinist and division foreman in the shops of the International & Great Northern at Taylor, Tex., and the following three months was with the Missouri, Kansas & Texas at Smithville, Tex., as a machinist. Mr. McQuillen went to the Gulf, Colorado & Santa Fe in September, 1901, and until December, 1902, was machinist and roundhouse gang boss at Temple, Tex. He was then made general foreman at Gainesville, Tex., and in November, 1906, was promoted to master mechanic at Silsbee, Tex., which position he held until his recent appointment as mechanical superintendent as above noted.

Hugh Montgomery has been appointed superintendent of motive power and rolling stock of the Rutland Railroad, with office at Rutland, Vt., succeeding F. C. Cleaver, resigned.

G. A. Schmoll has been appointed district superintendent of motive power of the Baltimore & Ohio, with headquarters at Pittsburgh, Pa. He was born November 23, 1862, at Fort Wayne, Ind., and began railway work in June, 1885, as an apprentice in the shops of the Pennsylvania Railroad. He later became machinist, and in January, 1902, was made shop foreman, leaving that company the following November to become motive power inspector on the Baltimore & Ohio. In June, 1903, he was promoted to master mechanic at Mount Clare, and seven years later he became superintendent of motive power at Wheeling, W. Va., remaining in that position until his appointment as district superintendent of motive power at the same place, which position he held at the time of his recent appointment as district superintendent of motive power at Pittsburgh, as above noted.

H. C. Van Buskirk has been appointed mechanical superintendent of the first district of the Chicago, Rock Island & Pacific, with headquarters at Des Moines, Iowa, succeeding J. B. Kilpatrick, resigned.

The headquarters of J. J. Waters, superintendent of motive power of the Pere Marquette, have been moved from Grand Rapids, Mich., to Detroit, Mich.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

A. B. Adams has been appointed master mechanic of the Atchison, Topeka & Santa Fe at Silsbee, Tex., succeeding J. E. McQuillen, promoted.

W. S. Butler, master mechanic of the Huntington division of the Chesapeake & Ohio, at Huntington, W. Va., has been appointed master mechanic of the West Virginia general division, with office at Hinton, W. Va.

J. L. Cunningham has been appointed master mechanic of the Philadelphia, Baltimore & Washington, at Wilmington, Del., succeeding C. G. Turner, resigned. Mr. Cunningham was born September 28, 1874, at West Fairfield, Pa., and in 1891 graduated from Blairsville, Pa., High School. In November of the same year he became machinist apprentice on the Pennsylvania Railroad at Altoona, Pa., and after completing his apprenticeship entered Purdue University, graduating with the class of 1900. In July of the same year he was appointed motive power inspector on the Pennsylvania Railroad at Philadelphia, Pa., and the following March was transferred in the same capacity to Pittsburgh. In December, 1902, he was made foreman of the Bedford division shops, at State Line, Pa., and one year later became assistant master mechanic at Harrisburg. He was appointed general foreman at Columbia, Pa., in October, 1904, and in April, 1906, was made assistant engineer of motive power at Williamsport, Pa., becoming master mechanic of the New York, Philadelphia & Norfolk in August, 1910, with headquarters at Cape Charles, Va., which position he held at the time of his appointment as master mechanic of the Philadelphia, Baltimore & Washington, as above noted.


J. L. Cunningham.

Foster Dewey has been appointed division foreman of the Atchison, Topeka & Santa Fe at Williams, Arizona, succeeding Chas. Johnson.

C. A. Kothe has been appointed master mechanic of the Cincinnati division of the Erie at Marion, Ohio.

Charles L. McIlvane has been appointed master mechanic of the New York, Philadelphia & Norfolk, with office at Cape Charles, Va. He was born September 25, 1876, at Wilmington Del., and was educated at the University of Pennsylvania. He began railway work as an apprentice in October, 1899, on the Philadelphia, Baltimore & Washington, at Wilmington, and in 1901 was made special apprentice at the Pennsylvania shops at Altoona, Pa. In January, 1903, he became draughtsman at Jersey City, N. J., and in March, 1905, was appointed inspector in the motive power department at the same place. The following month he was made assistant master mechanic on the Amboy division at Camden, and in May, 1907, became assistant engineer of motive power on the Buffalo & Allegheny Valley division at Buffalo, N. Y. From September, 1910, to May, 1911, he was assistant engineer of motive power of the Philadelphia & Erie and the Northern Central, at Williamsport, Pa., and then became assistant engineer of motive power in the office of the general superintendent of motive power at Altoona, Pa., which position he held at the time of his recent appointment as master mechanic of the New York, Philadelphia & Norfolk, as above noted.

J. E. Fowler has been appointed road foreman of engines of

the Atchison, Topeka & Santa Fe at Silsbee, Tex., succeeding D. Ross.

David Ross has been appointed road foreman of engines of the Atchison, Topeka & Santa Fe at Cleburne, Tex., succeeding C. C. Walker.

CAR DEPARTMENT

W. T. Cousley, chief car inspector of the Elgin, Joliet & Eastern, at Gary, Ind., has been appointed master car builder of the San Antonio & Aransas Pass, with headquarters at San Antonio, Tex.

SHOP AND ENGINE HOUSE

George T. Depue has been appointed superintendent of shops of the Erie Railroad at Galion, Ohio.

C. H. Giller has been appointed foreman boilermaker of the Atchison, Topeka & Santa Fe at Riverbank, Cal.

W. E. Goodwin has been appointed tool foreman of the Chicago & Alton at Bloomington, Ill.

C. B. Hitch, general foreman of the Chesapeake & Ohio at Covington, Ky., has been appointed general foreman of that road at Hinton, W. Va.

George Hoff, Jr., formerly special apprentice at the Altoona shops of the Pennsylvania, has been appointed an engine inspector at the Twenty-eighth street roundhouse of the same road.

H. W. Hunt has been appointed bonus demonstrator of the Atchison, Topeka & Santa Fe, with headquarters at Richmond, Cal., having charge of bonus demonstrating work on the Valley and Arizona divisions, succeeding J. R. Leverage, transferred.

J. R. Leverage has been appointed bonus demonstrator of the Atchison, Topeka & Santa Fe, with headquarters at San Bernardino, Cal., having charge of bonus demonstrating work at San Bernardino shops, Los Angeles and Albuquerque divisions, succeeding S. S. Lightfoot, promoted.

S. S. Lightfoot has been appointed bonus supervisor for the Atchison, Topeka & Santa Fe Coast Lines, with headquarters at Los Angeles, Cal., succeeding D. E. Barton, transferred.

John L. Miller has been appointed roundhouse foreman of the El Paso & Southwestern at Douglas, Ariz., succeeding W. C. Leland, promoted.

H. A. Prewitt has been appointed general foreman of the Atchison, Topeka & Santa Fe at Amarillo, Tex., succeeding H. H. Stephens.

E. M. Wilcox, division general foreman of the Chicago, Indiana & Southern and the Indiana Harbor Belt, has been appointed division general foreman of the Lake Shore & Michigan Southern, with headquarters at Englewood, Ill., succeeding George Thomson, promoted.

PURCHASING AND STOREKEEPING

G. W. Alexander, storekeeper of the Central of Georgia at Savannah, Ga., has been appointed division storekeeper of that road at Macon, Ga.

J. L. Bennett has been appointed purchasing agent of the Central of Georgia, with headquarters at Savannah, Ga., succeeding A. C. Mann.

A. C. Mann, purchasing agent of the Central of Georgia, at Savannah, Ga., has been appointed purchasing agent of the Illinois Central, with headquarters at Chicago, succeeding J. C. Kuhns.

F. K. Mays, treasurer of the Atlanta, Birmingham & Atlantic, at Atlanta, Ga., has been appointed purchasing agent of that road, also of the Georgia Terminal Company and the Alabama Terminal Railroad, in addition to other duties previously assigned to him, with headquarters at Atlanta, succeeding W. A. Hammel, resigned to go to another company.

G. E. McWhite has been appointed assistant purchasing agent of the Atlanta, Birmingham and Atlantic, with headquarters at Atlanta, Ga.

B. H. Rotureau, storekeeper of the Central of Georgia at Macon, Ga., has been appointed division storekeeper of that road at Savannah, Ga.

Thomas Spratt has been appointed assistant purchasing agent of the Norfolk & Western, with office at Roanoke, Va.

NEW SHOPS

Atchison, Topeka & Santa Fe.—Work will begin immediately on a new roundhouse at Temple, Tex., to cost about $25,000.

Atchison, Topeka & Santa Fe.—This company has asked bids on an eight-stall brick and concrete roundhouse at Silsbee, Tex.

Atchison, Topeka & Santa Fe.—This company has awarded a contract for a "Unit-Bilt" reinforced concrete 25-stall roundhouse at Redondo Junction, near Los Angeles, Cal., to the Van Sant Houghton Company of San Francisco.

Canadian Pacific.—This road will build another addition to its passenger car repair shop at Toronto, Ont. The new building will be one story high and will be built of brick with concrete foundation. John Hayman & Son Company, London, Ont., have secured the concrete contract for this building, which will cost about $26,000.

Portland, Eugene & Eastern.—It is reported that this road will begin work within 90 days on the construction of a machine shop and foundry at West Oregon City, Ore.

St. Louis Southwestern.—Work has commenced on a new 16-stall roundhouse at Texarkana, Tex.

St. Louis Southwestern.—This company, through a newly incorporated subsidiary called the Valley Terminal Association, has purchased about 140 acres of land on which to erect a roundhouse, shops and other terminal buildings, and a yard with a capacity of about 5,000 cars at East St. Louis, Ill.

Indian Railway Mileage.—During the calendar year of 1912, 668 miles of new line were opened to traffic in India, bringing the total mileage in operation up to 33,484 miles. This figure comprises 17,189 miles of 5 ft. 6 in gage; 14,165 miles of 3 ft. 3 in. gage; 1,692 miles of 2 ft. 6 in. gage, and 438 miles of 2 ft. gage.

Traffic Through Harlem River Yard.—During the month ending July 15, 1913, 1,721 carloads of potatoes from the South passed through the Harlem River yard of the New York, New Haven & Hartford, destined for cities in New England, an average of 54 cars a day. In the same time there were sent through this yard 467 carloads of watermelons, 135 of cantaloupes, 112 of berries and 98 carloads of peaches. The movement of freight cars through this yard, eastbound and westbound, now amounts to about 5,000 a day.

Electrification of Melbourne Suburban Railways.—The Electrification Committee has been meeting frequently to arrange details of the scheme. Among the principal questions considered have been those in connection with the bonding of the rails for the transmission of electrical energy, the provision of the requisite number of carriages suitable for electric traction, and the structural alterations in the bridges on the route. A commencement has been made with the construction of the loop line to the site of the new power house to be erected.

SUPPLY TRADE NOTES

The National Tube Company, Pittsburgh, Pa., announces that commencing August 1, 1913, it will enter the electrical conduit field.

The Goldschmidt Thermit Company, New York, has moved its San Francisco, Cal., office from 432 Folsom street, to 329 Folsom street.

A. L. Whipple has resigned his position as vice-president of the Standard Heat & Ventilation Company, New York, with office in Chicago, to enter the railway supply business on his own account.

L. C. Noble, vice-president of the Pittsburgh Spring & Steel Company, died at his home in Evanston, Ill., July 25. Mr. Noble was born at Ann Arbor, Mich., July 24, 1842. In October, 1862, he became foreman of the machine shop of the Detroit Locomotive Works, holding that position until 1863. From 1863 to 1867, he was employed in the shops of the Chicago & North Western at Chicago. From 1872 to 1874, he was general foreman of the Houston & Texas Central, and in May, 1874, was appointed general master mechanic for the same road. Subsequently he was for several years prior to 1890 superintendent of motive power of the same road. In 1890 he became associated with the A. French Spring Company, as western manager of sales, and in 1902 he resigned that position to become vice-president of the Pittsburgh Spring & Steel Company, with office at Chicago, which position he held at the time of his death.

L. C. Noble.

The Mid-Western Car Supply Company, Chicago, which was declared bankrupt on May 20, 1913, has filed an application for the discharge of its debts. A hearing will be held in Chicago on October 6.

C. R. Weaver has been made vice-president of the L. J. Bordo Co., Philadelphia, Pa., maker of Bordo blow-off valves, succeeding C. W. Allen, resigned. Mr. Allen has also resigned his position as a director of this company.

The American Locomotive Company, New York, has decided to discontinue the manufacture and sale of Alco automobiles and motor trucks. The automobile department, since its start in 1905, has been unprofitable to the company, and the prospects for the future of carrying on the business successfully are so uncertain as not to warrant, in the judgment of the directors, the continuance in this field of industry. The company will continue to make repair parts for its automobiles for a period of not less than five years.

District Judge Thomas I. Chatfield, sitting in the United States district court for the Eastern district of New York, handed down a decision on June 12 in *Heinrich L. I. Siemund vs. Joseph Enderlin, Sr., and Joseph Enderlin, Jr., doing business under the firm name and style of Joseph Enderlin, Jr., & Co.*, dismissing the complaint against the defendants for infringement on electrical welding patents. It was found that the complainant, the defendants and others had been applying the teachings of the Bernados method of electrical welding, as improved upon by Coffin and Kjellberg through the use of a metal electrode. They had found that under certain relative conditions of size of parts and strength and quantity of current, an experienced workman could weld upon an overhead surface, but Siemund was the first man who described to the patent office, or who expressed in writing a definite description of the proportion and arrangement of the entire apparatus and the method of the manipulation of the parts when making a successful overhead weld. The court found that such a description was not the invention of a method; also that an arrangement of the parts of a device cannot be patentable as a new invention when the earlier patents show both an understanding of the possibility of these results and the existence of such an arrangement of parts and of the conditions produced, even though the explanation of the cause of the results themselves be mistakenly stated. For seven or eight years prior to the Siemund experiments, Enderlin was welding by the method of electric current, of substantially the proportions needed for the Siemund method, and by the use of a metallic electrode of such small size as to produce a voltaic arc, manipulated in almost the identical way which Siemund later patented. The court decided that even if the particular improvements upon the Bernados method were patentable, or if the particular device showed patentable novelty, the Siemund patent must be held invalid when tested from the standpoint of the defendant's prior use.

Alfred Atmore Pope, president of the National Malleable Castings Company, Cleveland, Ohio, died at his home in Farmington, Conn., on August 5. Mr. Pope was born in North Vassalboro, Me., in 1842. In his early boyhood his family moved to Salem, Ohio, where he spent his school days, and, a few years later, to Cleveland, Ohio, where Mr. Pope's business experience began. After five or six years as a partner in the woolen manufacturing business his connection with the malleable iron business began in the year 1869. This became the leading commercial interest of his life and he, associated with his partners, was foremost in developing the present process of making malleable iron and in extending its manufacture, until now it has become one of the important iron industries of the country.

A. A. Pope.

Rare patience, foresight, sound judgment, absolute justice, untiring devotion to detail, and a gift for inspiring and rewarding the best efforts and stimulating the best qualities of other men were among the striking elements of Mr. Pope's successful career. Under his leadership the Cleveland Malleable Iron Company rapidly grew in importance and reputation and its operations extended in the course of years to other communities, resulting finally in the great group of the malleable iron and steel casting plants of The National Malleable Castings Company at Cleveland, Chicago, Indianapolis, Toledo, Sharon, and Melrose Park.

The Eberhard Manufacturing Company of Cleveland, established in 1879, for producing light and special castings, has developed from small beginnings into one of the largest manufacturers of vehicle and saddlery hardware in the world. The Ewart Manufacturing Company of Chicago and Indianapolis,

now a part of the Link-Belt Company, originators of detachable link belting, is another of the large enterprises which grew and developed under Mr. Pope's management.

At the time of his death Mr. Pope was president of The National Malleable Castings Company and The Eberhard Manufacturing Company, which positions he had held since their organization. He was director in the Link-Belt Company of Chicago, the North & Judd Manufacturing Company and the Landers, Frary & Clark Company of New Britain, Conn., the Indiana & Michigan Electric Company of South Bend, Ind., the Colonial Trust Company of Waterbury, Conn., and the Century Bank of New York. He was a member of the Advisory Board of the Guardian Savings & Trust Company, Cleveland; trustee of Western Reserve University; president of Westover School, Middlebury, Conn.; member of the Royal Society of Fine Arts, London; a member of the Visitors' committee of the Fogg Museum of Fine Arts of Harvard University.

FEDERATION OF TRADE PRESS ASSOCIATIONS

The annual convention of the Federation of Trade Press Associations will be held at the Hotel Astor, New York, September 18-20. The subject of the opening meeting on the morning of September 18 will be Business Promotion Through Trade Press Efficiency, which will be followed by addresses by President H. M. Wilson of the New York Trade Press Association, President H. M. Swetland of the Federation of Trade Press Associations, Secretary-Treasurer E. C. Johnston, of the same association, and by the presidents of the various local associations. R. R. Shuman, of the Shuman-Booth Company, Chicago, will deliver an address on The New Force in Business, which will be followed by an address on The Weakest Spot in Trade Press Efficiency by Elton J. Buckley, editor of *The Grocery World and General Merchant.*

Lunch will be served at the Thirty-ninth Street Publishers' building, followed by an inspection of the plant and publishing offices of the Federal Printing Company. The editorial symposium, under the leadership of A. I. Findley, of the *Iron Age,* will be held on the afternoon of September 18. At this symposium will be presented papers on general editorial subjects; also on the relations of editors with other departments. On the same afternoon there will be the circulation symposium under the leadership of M. C. Robbins, at which papers will be presented from subscription managers, canvassers, and subscribers, giving views as to the value of the trade press and wherein it fails to be of value to them.

On September 19 there will be the advertising symposium, which will be under the leadership of Hugh M. Wilson, and at which papers will be presented by educators, publishers, advertisers, advertising managers and advertising agents. At the business meeting will be told the inside stories of some of the big trade paper publishing successes. These speakers will treat the fundamental principles upon which each business was built. H. M. Swetland, president, will preside.

In the afternoon there will be a mass meeting at which there will be a number of addresses by representative men on subjects of live interest to editors, publishers and advertisers. The banquet will be held on the evening of September 19 at the Hotel Astor. John Clyde Oswald, of the *American Printer,* will be toastmaster. The speakers will include the Hon. Albert S. Burleson, postmaster general; the Hon. William C. Redfield, secretary, Department of Commerce; John Kendrick Bangs, Tom Daly, the Hon. Charles F. Moore and Dr. N. M. Waters.

The publishers' symposium will be held on the morning of September 20. Here will be discussed the policies, standards, and ideals of the trade paper publishing business. This symposium will be under the leadership of E. R. Shaw, of *The Practical Engineer.*

William H. Ukers, 79 Wall street, New York City, is chairman of the committee on arrangements.

CATALOGS

Electric Hoists.—Electric driven hoists in any practicable size and arranged for all ordinary uses are shown in a catalog from the Lidgerwood Manufacturing Company, 96 Liberty street, New York. These hoists are of the type especially suited for contractors' work.

Twist Drills.—The new catalog (No. 16) of the Detroit Twist Drill Company, Detroit, Mich., contains 109 pages entirely devoted to twist drills, reamers, chucks, sockets and milling cutters. The section on drills is the largest part of the book and these are shown in many styles with various types of shank. The Detroit grooved shank system is given prominent mention. On each page is a table showing the complete range of sizes for each type of drill together with the price for both carbon and high speed steel. The proper procedure for grinding twist drills is explained on one of the pages.

Vertical Boring and Turning Mills.—A leaflet which is to be included in the binder furnished by the Gisholt Machine Company, Madison, Wis., gives an illustration and brief description of the 52-in. vertical boring and turning mills manufactured by this company. These mills are provided with a turret head holding five tools, and also a side attachment for cutting on the edge of revolving work.

Exhaust Fan Outfits.—Motor driven exhaust fan outfits for both direct and alternating current of various styles and sizes are shown in bulletin No. 246 from the Sprague Electric Works of the General Electric Company, Schenectady, N. Y. The fans are illustrated by photographs and line drawings showing the over-all dimensions. The tables show the capacity under different conditions and with different sizes.

Electric Arc Welding Processes.—A paper on electric arc welding by C. D. Auel, director of processes, standards and materials of the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., is being reprinted by that company. This paper is well illustrated and explains in an interesting manner the different processes used in arc welding, their advantages and limitations and gives some interesting figures of comparison of arc and blacksmith welding.

Electric Girders.—Bulletin E-29 which supersedes E-24 is being issued by the Chicago Pneumatic Tool Company, Fisher Building, Chicago. Portable electric grinders in various arrangements and sizes are the subject of this bulletin. Each is illustrated, briefly described and a table is given showing the weight and sizes of the machine. The same company is also issuing a new bulletin on enclosed self-oiling type of air compressors for both steam and belt drive. The description of these compressors is thorough.

Ball Bearings.—S. K. F. self-alineing radial ball bearings are fully illustrated and the characteristic features of the design fully explained in bulletin No. 9 being issued by the S. K. F. Ball Bearing Company, 50 Church street, New York. The catalog explains how the rating of ball bearings is obtained and tables are included showing the maximum load per pound for various revolutions that is recommended in each size. These tables also include the dimensions of the complete bearing, size of the ball and the weight. Both radial and thrust bearings are considered.

Automatic Connectors.—The Robinson automatic connectors for air hose is of the full-face, straight port type and employs the minimum number of parts, giving a very light weight and minimum interference. For passenger service this connector weighs 40 lbs. and for freight service about 30 lbs. It employs a hose from the connector head to the train line angle cock and is carried by a connection to the coupler shank. This connector is manufactured by The Robinson Coupler Company, Washington, D. C. It is fully illustrated and described in a catalog being issued by this company.